Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LIX. SEPTEMBER, 1920. No. 3.

CONTENTS

EDITORIALS

Wanted: Some Horrible Examples 81
The Time Element in Engineering Literature 81
Alderman Advises Engineers to Maintain Lobby 82
The Gray Wolf Died Poor 82

LEADING ARTICLES

Novel Construction Methods Employed on Morris-Ottawa, Illinois Concrete Road 83
Foundations for Asphaltic Pavements 85
National Conference on Engineering Employment 86
The Utilization of Municipal Waste 86
What is the Future of Engineering? 87
Comments on the "Kirdorthoff," or Modified Imhoff, Tanks 88
Some Features of Garbage Disposal by Hog Feeding at Baltimore, Md. 90
Design and Construction of the Memorial Bridge at Des Moines, Iowa 91
Handling Motor Truck Traffic on Trunk Highways of Marquette County, Mich. 94
Engineering Phases of the Water Situation in California 95
An Engineer's Thoughts on Americanization 98
Snow Removal in Fargo, North Dakota 100

WATER WORKS SECTION

Method Employed in Closing a Leak Under a Dam 101
Increasing Economy of St. Louis Water Works Pumping Plans 102
Sewage Treatment to Protect Water Supplies 111

CONSTRUCTION NEWS AND EQUIPMENT SECTION

Construction Equipment Employed in Building Reinforced Concrete Pavement on Jefferson Highway, Rice County, Minn. ... 21
New Method of Handling Concrete Material on Minneapolis Paving Job 22
Largest Mixers Back in Service After 60-Ft. Fall 24
Lauson Special Road Tractor 26

INDEX TO ADVERTISEMENTS

	Page
Acme Motor Truck Co., Cadillac, Mich.	19
Alvord, John W., & Charles B. Burdick, Chicago, Ill.	114
American Cast Iron Pipe Co., Birmingham, Ala.	116
American Steel & Wire Co., Chicago, Ill.	Inside front cover
American Telephone & Telegraph Co., New York, N. Y.	25
Artingstall, Wm., Chicago, Ill.	114
Asphalt Association, The, New York, N. Y.	
Austin-Western Road Machinery Co., Chicago, Ill.	36
Austin Machinery Corporation, Chicago, Ill.	Back cover
Barber Asphalt Paving Co., Philadelphia, Pa.	5
Barrett Co., The, New York, N. Y.	99
Bitoslag Paving Co., New York, N. Y.	Inside Front Cover
Brossman, Chas., Indianapolis, Ind.	114
Burd & Giffels, Grand Rapids, Mich.	114
Buyers' Guide	32, 34
Cannelton Sewer Pipe Co., Cannelton, Ind.	115
Carey Company, The Philip, Cincinnati, O.	4
Cast Iron Pipe Publicity Bureau, New York, N. Y.	109
C. H. & E. Manufacturing Co., Milwaukee, Wis.	35
Chicago Paving Laboratory, Chicago, Ill.	114
Cincinnati Iron Fence Co., Cincinnati, O.	6
City Wastes Disposal Co., New York, N. Y.	114
Clay Products Association, Chicago, Ill.	
Cleveland Stone Co., The, Cleveland, O.	8
Coldwell-Wilcox Co., Newburgh, N. Y.	116
Crane Co., Chicago, Ill.	
Cummer & Son Co., The F. D., Cleveland, O.	31
Dee Clay Mfg. Co., W. E., Chicago, Ill.	8
Dee, Wm. E., Chicago, Ill.	116
De Laval Steam Turbine Co., Trenton, N. J.	105
De Smet Quartz Tile Co., Chicago, Ill.	
Direct Oxidation Process Corp., Philadelphia, Pa.	116
Dow & Smith, New York, N. Y.	114
Duplex Truck Co., Lansing, Mich.	11
DuPont DeNemours & Co., E. I., Wilmington, Del.	2
Early Producing and Refining Association, Marceline, Mo.	Inside front cover
East Iron and Machine Co., The, Lima, O.	27
Elgin Sales Corp., New York, N. Y.	8
Engineers and Contractors	114, 115
Flood, Walter H., Chicago, Ill.	114
Flower Valve Mfg. Co., Detroit, Mich.	
Gannet, Seeyle & Fleming, Harrisburg, Pa.	114
Garford Motor Truck Co., Lima, O.	18
Good Roads Machinery Co., Inc., Philadelphia, Pa.	
Gramm-Bernstein Motor Truck Co., Lima, O.	
Greeley, Samuel A., Chicago, Ill.	114
Harris Air Pump Co., Indianapolis, Ind.	
Heltzel Steel Form and Iron Co., Warren, O.	19
Howard, J. W., New York, N. Y.	114
Jones, Sam L., Cincinnati, O.	114
Kalamazoo Foundry and Machine Co., Kalamazoo, Mich.	116
Kentucky Rock Asphalt Co., Louisville, Ky.	
Kirchoffer, W. G., Madison, Wis.	114
Kissel Motor Car Co., Hartford, Wis.	13
Koehring Machine Co., Milwaukee, Wis.	23
Kolesch & Co., New York, N. Y.	29
Lewis-Hall Motors Corporation, Detroit, Mich.	20
Littleford Bros., Cincinnati, O.	27
Lufkin Rule Co., The, Saginaw, Mich.	8
Madison Foundry Co., Cleveland, O.	116
Mayer, F., Chicago, Ill.	35
Mead-Morrison Manufacturing Co., South Boston, Mass.	15
Medal Paving Brick Co., Cleveland, O.	31
Metropolitan Paving Brick Co., Canton, O.	
Motor Truck Section	9—20
Murphysboro Paving Brick Co., Murphysboro, Ill.	31
National Paving Brick Mfrs. Assn., Cleveland, O.	
New Orleans Refining Co., New Orleans, La.	8
Olsen Testing Machine Co., Philadelphia, Pa.	115
Packard Motor Car Co., Detroit, Mich.	
Pawling & Harnischfeger Co., Milwaukee, Wis.	107
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	116
Pierce-Arrow Motor Car Co.	16, 17
Pioneer Asphalt Co., Lawrenceville, Ill.	6
Portable Machinery Co., Inc., Passaic, N. J.	24
Potter, Alexander, New York, N. Y.	114
Republic Creosoting Co., Indianapolis, Ind.	8
Rosing, Inc., Astrid S., Chicago, Ill.	115
Sauerman Bros., Chicago, Ill.	24
Shields, W. S., Chicago, Ill.	115
Sinclair Refining Co., Chicago, Ill.	
Smith Co., The T. L., Chicago, Ill.	27
Springfield Paving Brick Co., Springfield, Ill.	6
Standard Oil Co. (Indiana), Chicago, Ill.	Inside back cover
Stewart, W. H., St. Louis, Mo.	116
Sullivan, Long & Hagerty, Bessemer, Ala.	115
Texas Co., Asphalt Sales Dept., New York, N. Y.	7
Truscon Steel Co., Youngstown, O.	6
United States Cast Iron Pipe and Foundry Co., Burlington, N. J.	111
Uvalde Asphalt Paving Co., New York, N. Y.	31
Van Trump, Isaac, Chicago, Ill.	115
Warren Brothers Co., Boston, Mass.	1

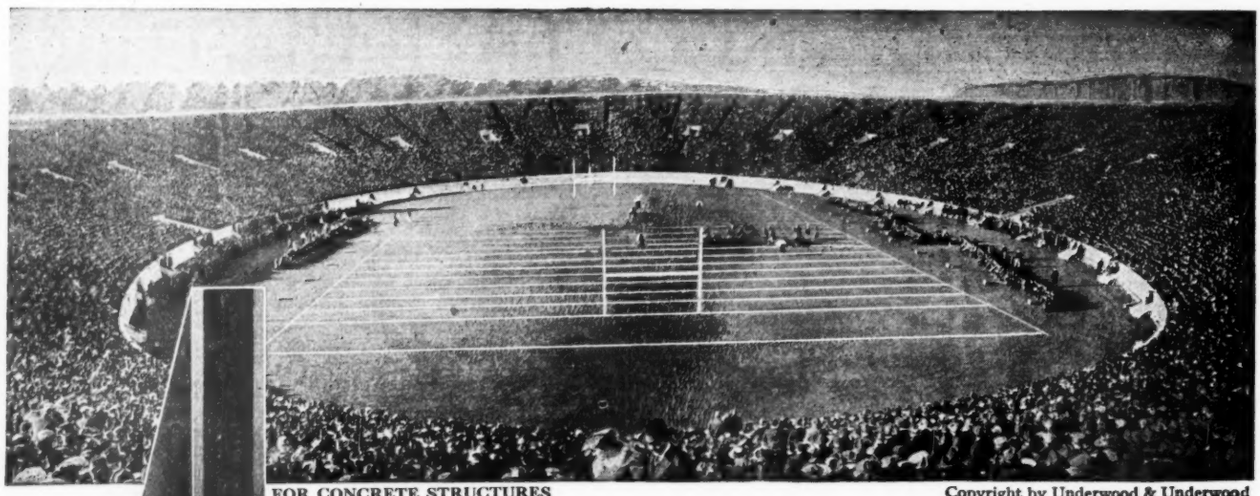
MUNICIPAL AND COUNTY ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA, A. P. Fox, President; J. H. Pritchard, Secretary.

Editorial and Advertising Offices, 538 S. Clark Street, CHICAGO, ILLINOIS. Samuel C. Hadden, Editor and General Manager.

Single copies, 25 cents. The yearly subscription price in the United States and its Possessions, Cuba and Mexico, is $2.00; in Canada, $2.40; and in all other countries, $2.75.

Entered as second-class matter July 1, 1899, at the Post Office at Indianapolis, Indiana, under Act of March 3, 1879.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL AND COUNTY ENGINEERING, Indianapolis, Indiana. Editorial and business communications should be addressed to 538 S. Clark St., Chicago, Illinois.



FOR CONCRETE STRUCTURES

Copyright by Underwood & Underwood

STREETS

SIDEWALKS

HIGHWAYS

THE SPERRY ENGINEERING COMPANY
(INCORPORATED)
CONSTRUCTING ENGINEERS
82 CHURCH ST.
NEW HAVEN, CONN.

Address all communications to the Company.

SUBJECT

Feb. 22, 1915,

The Philip Carey Co.,
Cincinnati, Ohio.

Gentlemen -

In the building of the Yale Bowl we used a large quantity of your so-called Elastite, ½" thick, in the expansion joints of the concrete work, and I thought you would be interested to know how it was used and with what success. It was easy to handle and when placed made a perfect joint and acted in all ways as an expansion joint.

We are glad to say that should occasion arise we shall use it again

Yours very truly,

SPERRY ENGINEERING COMPANY.
AWS:T A WILLIAM SPERRY,
President.

For samples and details about the use and cost of the original felt walled asphalt expansion joint write—

THE PHILIP CAREY COMPANY

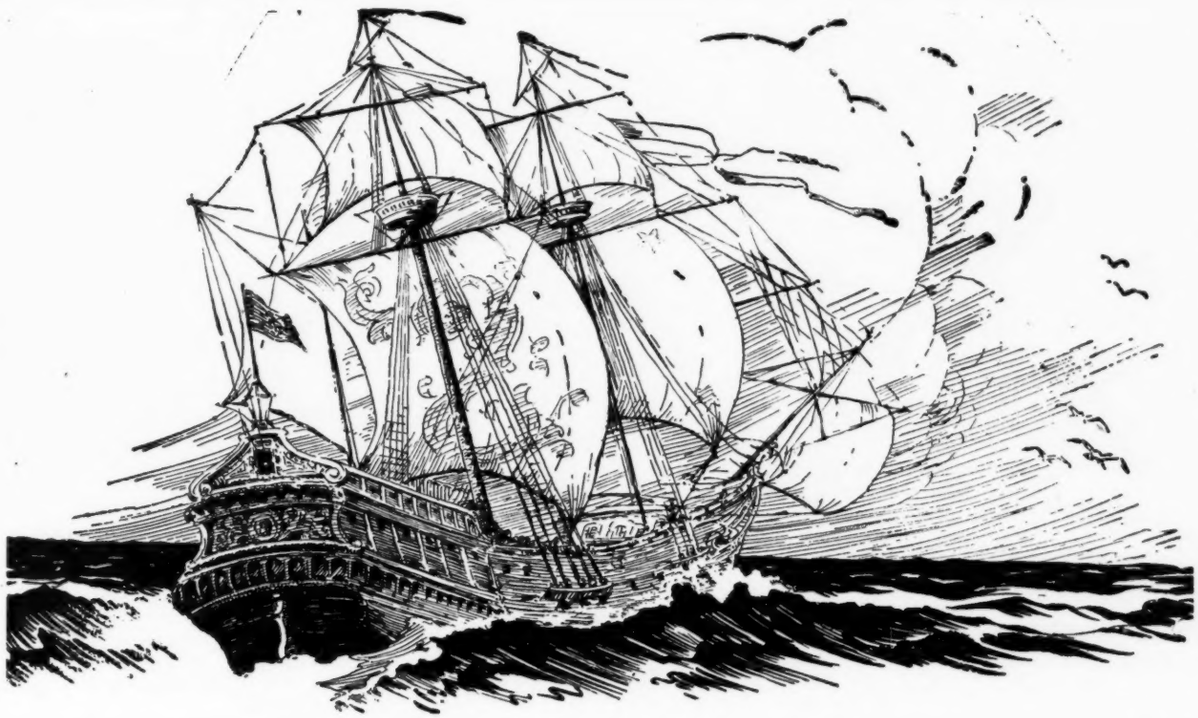
33 Wayne Avenue, Lockland, Cincinnati, Ohio

Carey Elastite

NAME REG. U.S. Patent Office

EXPANSION JOINT

E-9



On Raleigh's caulked "shippes"

—just as on thousands of modern streets—Trinidad Lake Asphalt has proved *"most excellent good, and melteth not in the sun."* Nature made, its quality and durability are unchangeable. Three and a quarter centuries—the span since Raleigh's time—are but a day—an hour—a minute in the life of

TRINIDAD LAKE ASPHALT

Wind-swept, sun-baked and storm-drenched in the tropics for ages, Trinidad Lake Asphalt has been weather-beaten into the most durable paving material known. It is impervious to water and frost, and without equal for long life and low maintenance.

TRINIDAD RECORD NO. 3

That No Other Bituminous Paving Material Can Equal.

Washington, D. C.—11 streets paved with Trinidad Lake Asphalt in 1889. Now 31 years old and still in good condition.

Maintenance cost to date one cent per yard per year.

Write for "THE ASPHALT TIME TABLE"

The Barber Asphalt Paving Company

Philadelphia

Iron Fence

Beautifies and Protects Buildings

A PUBLIC building without iron fence seems bare and unfinished. An attractive iron fence adds the touch of artistic beauty, and in addition insures adequate protection for untold years to come.

We originate special designs or make fence according to your own specifications.
Full and cordial cooperation with architects, committees and boards, engineers.

Write for illustrated Catalog TODAY.

Cincinnati Iron Fence Co.

3304 Spring Grove Ave. CINCINNATI, OHIO

Manufacturers of Ornamental Iron Work, Plain and Ornamental Steel and Iron Fencing, Flower Vases, Settees, Wire and Iron Window Guards, Pipe Railing, Folding Gates, Etc.

PIONEER Highest Quality ASPHALTS

PIONEER Highest Quality ASPHALTS

"PIONEER"

Highest Quality Asphalts

Any Melting Point, Any Ductility, Any Penetration

OUR POLICY: "A personal interest in every order, An earnest endeavor to please."

"PIONEER"

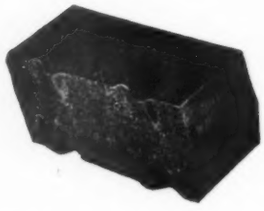
Ruberoad Cement

It's New It's Different It's Efficient

Especially made and adapted for repairing cracks in concrete roads and pavements, and for repairing bituminous pavements. Applied cold—does not interfere with traffic.

THE PIONEER ASPHALT CO.
LAWRENCEVILLE, ILL.

Springfield Wire-Cut Lug



IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

Truscon Curb Bars

Protection for Concrete Curbs— Corners of Walls, Columns, etc.

Truscon Curb Bars provide a substantial protection and reinforcement for concrete curbs, also for exposed corners of walls, pilasters, columns, platforms, sidewalks, etc. Manufactured from open hearth steel, heavily galvanized after forming. Positive anchorage—no separating or splitting of concrete at corners. Owing to their rigidity and convenient size, Truscon Curb Bars are easy to handle and install. Furnished either straight or curved; 1⅝-in. protecting edge.

Truscon Edge Protectors provide a 1-in. protection edge, ample for many conditions, such as corners of platforms, walls, etc.

TRUSCON STEEL CO TRUSCON BUILDING PRODUCTS

TRUSCON STEEL CO.

Youngstown, Ohio

Warehouses and Sales Offices in Principal Cities

Reinforcing Steel, Metal Lath, Steel Windows, Steel Buildings, Pressed Steel, Cement Tile, etc.

TEXACO

To Resurface Worn Brick

Preparing worn brick pavement for resurfacing with TEXACO asphalt.

CUTS COST

To resurface a worn brick pavement with asphalt costs 35 to 45 per cent. less than a new brick surface.

A tremendous saving for any city or town that has worn brick pavements!

Laying binder course on worn brick pavement before putting down TEXACO wearing surface.

RAPID WORK

Rapid construction is a feature of resurfacing worn brick with asphalt. Traffic is unhampered as the work may be done on one side of the street at a time.

Cherry Street, Kansas City, Mo., showing TEXACO Asphalt pavement laid in 1911 over old brick. Photograph taken 1919.

CITIES DOING IT

Such cities as Kansas City, St. Louis, and St. Joseph in Missouri, Topeka and Wichita in Kansas, Lincoln and Beatrice in Nebraska, Fort Smith in Arkansas, Parkersburg in West Virginia, and other municipalities in the East, West and South are getting entire satisfaction from worn brick streets resurfaced with TEXACO Asphalt.

How to resurface a Worn Brick Pavement with Asphaltic Concrete or Sheet Asphalt.

Cross Section

1. Remove all crushed brick and clean out holes.
2. Flush and clean old brick surface.
3. Paint coat old brick when it is thoroughly dry.
4. Fill holes and depressions of old brick with Asphaltic Concrete.
5. Lay two inch Asphaltic Concrete or Sheet Asphalt surface.

(Specifications Furnished on Request)

The Texas Company

ASPHALT SALES DEPARTMENT

17 Battery Place New York City

New York	Jacksonville	Chicago	Houston
Philadelphia	Tampa	Cleveland	Des Moines
Richmond	New Orleans	Oklahoma City	Minneapolis
Boston	Memphis	Kansas City	Wichita

WM. E. DEE CLAY MFG. CO.

Proprietors of MECCA CLAY WORKS

MANUFACTURERS OF

STANDARD AND DOUBLE STRENGTH

Sewer Pipe, Drain Tile, Culvert Pipe, Well Tubing, Flue Lining, Wall Coping and Fire Brick.

WORKS { Mecca, Parke County, Ind., on C. & E. I. R. R.
Newport, Vermillion County, Ind., on C. & E. I. R. R.

Chicago Office, 30 N. LaSalle St.

Faultless Service in Every Respect

THAT'S WHAT YOU NEED WHEN TAKING MEASUREMENTS

That's what you can rest assured you are getting when you use

LUFKIN TAPES

PIONEERS IN CONNECTION WITH THE NOTEWORTHY IMPROVEMENTS MADE IN TAPES

More of them are in use than all other makes because they have for years consistently maintained the highest reputation. Send for Catalog No. 26.

THE LUFKIN RULE CO. SAGINAW, MICH.
NEW YORK. LONDON, ENG. WINDSOR, ONT.

The ELGIN LINE
OF
Motor Driven Street Cleaning Machinery

Elgin Sales Corporation

501 Fifth Avenue, New York — U. S. A. — 1340 Old Colony Bldg., Chicago

---

"BEREA" Sandstone Curbing

Pioneer in the field

PRODUCED BY

The Cleveland Stone Co.

Main Offices:
Union Bldg., 1836 Euclid Ave. CLEVELAND, OHIO

Western Offices:
Room 1112 Merchants Loan & Trust Bldg., Chicago

NORCO
Asphalts and Road Oils

ENDORSED BY LEADING AUTHORITIES

PRODUCED BY

New Orleans Refining Company
INCORPORATED

Refinery: Good Hope, La.

Offices: Maison Blanche Annex, New Orleans, La.

Advantages-

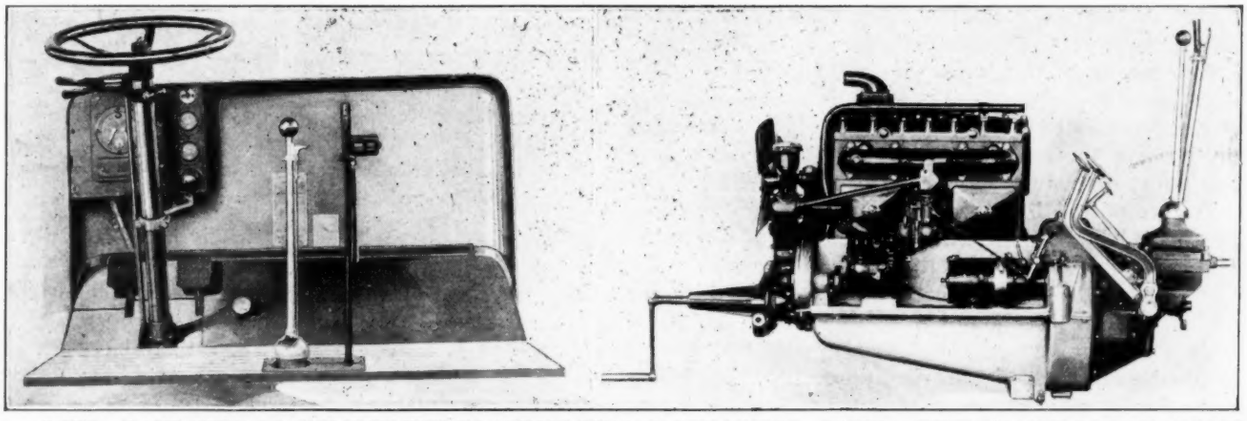
of WOOD BLOCK PAVEMENTS
Extended for Years With

No Bleeding — REILLY'S IMPROVED PERMANENT CREOSOTE OIL — *No Bulging*

Republic Creosoting Company, Indianapolis, Ind.
Plants: Indianapolis Minneapolis Mobile Seattle Norfolk

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



LEFT. DASH VIEW OF THE NEW PIERCE-ARROW DUAL VALVE TRUCK. RIGHT: VIEW OF NEW PIERCE-ARROW DUAL VALVE ENGINE CLUTCH AND TRANSMISSION ASSEMBLY, SHOWING THE PIERCE-ARROW DELCO DOUBLE IGNITION SYSTEM.

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, Chicago, Ill., September, 1920.

MOTOR TRUCK OPERATION AND ACCOUNTING LXI

Report Your Records

Readers of this department of MUNICIPAL AND COUNTY ENGINEERING are urged to send in the facts and figures covering their experiences in the use of motor trucks in our field. There are now so many trucks in operation that a great fund of information on their performance should now be available. The great difficulty has been in getting the facts into the records. Much has been accomplished in this direction, here and elsewhere, but while motor transportation is still young and growing we hope the individual reader will feel that he should contribute his knowledge on the subject to the general fund of information.

Some Bankers' Opinions of the Future of Truck Haulage

Some extracts are here published from letters written during the month of June of this year to Mr. E. A. Williams, Jr., President of the Garford Motor Truck Co., by prominent bankers, as reproduced by that company in a very timely and instructive pamphlet. Mr. Williams received the letters in reply to his request for bankers' opinions of the future of truck haulage. The letters should indeed be instructive to those who resent the development of the truck for any reason. Bankers certainly are conservative and if they agree that trucks are a modern necessity and are here to stay that should make it unanimous. The extracts from the letters follow:

Mr. J. A. Bower, Vice President of The Liberty National Bank, New York, wrote:

"It would seem to me that your inquiry is answered by the simple statement that I believe the truck industry is in its infancy and that it is becoming more and more a part of the great transportation facilities needed in these States because of the large area over which our population is distributed.

"At this particular time when freight handling is so inadequate it occurs to me the motor truck, through utility, has become a necessity. When transportation facilities become abnormal due to war and interrupted railway service the motor truck becomes an important factor.

"As a matter of fact, these new giants of industry are advantageously employed at present relieving congested freight conditions. For confirmation of this one need only observe the fleets of trucks which pass over any main artery of travel. I am told that not alone are foodstuffs transported but raw material of all descriptions, most of which are vital to the manufacture of commodities for use in our everyday life.

"With the railroads facing a shortage of equipment and taking into consideration the fact that the truck offers a haulage economy and touches many points off the usual main lines of transportation, thus being essential to food producers, one cannot doubt that the motor truck has won its place as a staple commodity and is a compelling factor in our transportation problems. In view of these facts it is difficult to see how the motor truck can be classed as a luxury."

The First Vice President of the Bank of the Manhattan Co., New York, wrote:

"On previous occasions I have discussed with you the increasing importance of the motor truck as an adjunct to our National transportation system. I wonder if you have recently been over any of the principal highways of New York, New Jersey, and New England to observe the real service which the motor truck is performing at this time when the East is suffering from the worst freight tie-up in history. The roads leading from New York to Philadelphia, Boston, Albany and intermediate points are literally covered with loaded motor trucks passing in both directions bearing the names of well known cities and towns which formerly depended entirely upon the railroads for the transportation of freight.

"I do not know what New York City would do at the present time without the motor truck, which at the moment is furnishing the only means for the prompt transportation of freight between points adjacent to this city. This is particularly true in the matter of perishable fruit and vegetables which at this season of the year reach New York from the farming country within 100 miles of us.

"The present freight situation clearly emphasizes the value of the motor truck as a permanent institution and in my opinion the development and extension of highways to accommodate motor trucks in order to carry short-haul freight, and thus relieve the railroads by leaving their tracks and terminals open for the prompt and efficient handling of through freight, is a matter worthy of prompt and serious consideration."

The Vice President of the Cleveland Trust Co., Cleveland, Ohio, said, in part:

"Industry must of necessity employ a medium supplemental to the railroads to move goods to market. Granting that certain long haul trucking operations now necessary will be discontinued after restoration of adequate railroad service, it seems evident that with the increasing improvement of highways, trucks will come into more general use as feeders to railroads.

"Our city streets today give ample evidence that there is no longer a problem of cost as compared to horse haulage."

The President of the Home Savings Bank Co., Toledo, Ohio, said, in part:

"The most instant relief, especially in short hauls, can be had by the use of the motor truck, which has now been developed by certain companies to a point which is believed to be near perfection. This is especially true in those parts of the country where there has been sufficient foresightedness to put the roadways into the state that all of our main roadways should, and must eventually, be. The motor truck should be recognized as a necessary implement with which to do business, and the

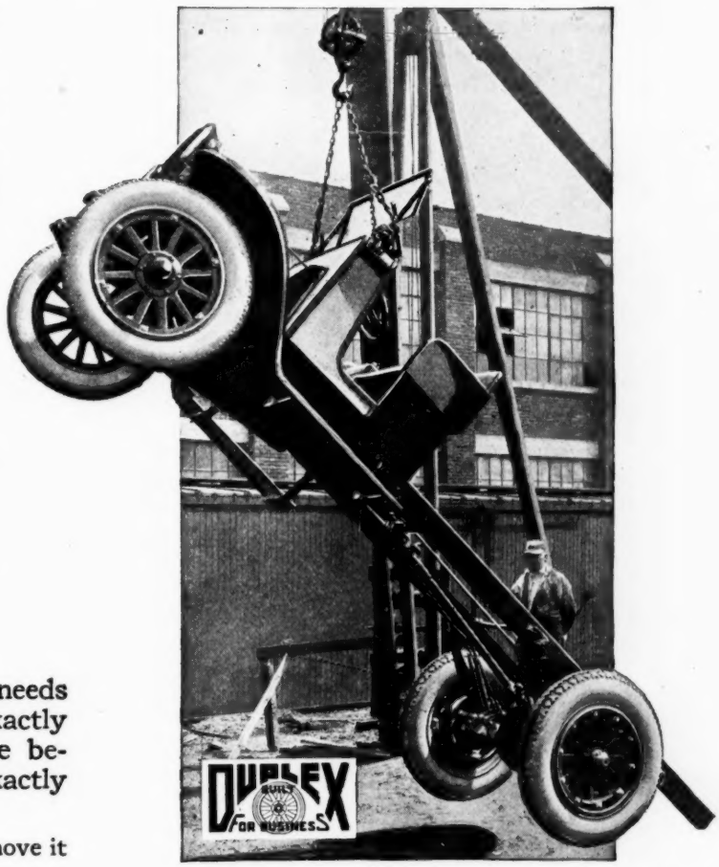
DUPLEX TRUCKS

BUILT FOR BUSINESS

AN actual photograph of a Duplex Limited being lifted clear of the ground by a cable around the windshield frame.

This wonderful strength in the cowl, while perhaps startling, is still only typical of the extra strong, rigid construction of the Duplex Limited in every detail and in every part.

It is this great Duplex strength and honesty of mechanical construction that makes the Duplex Limited a truck that a business man can buy and use on a practical business basis.



The Duplex *Limited*

Speed and Power to Spare—3000 to 5000 Pounds at 5 to 25 Miles an Hour on High and the Motor Turning Over Only 1300 R. P. M.

* * * *

Free from Vibration—Scientifically Balanced — Electrically Equipped — Pneumatic Tired—Here is a Truck a Business Man Can Buy and Use on a Business Basis

SPEED and staying power are the big needs of the hour in trucks—and here is exactly the right truck for general business use because it is scientifically built for just exactly that kind of work.

Its balance is so perfect that one man can move it over the floor.

Its motor is so large and so powerful that *no special gear reductions were necessary*. The motor turns over only 1300 R. P. M. to develop rated speed with full load.

It hauls 3000 to 5000 pounds of any kind of freight.

It holds the road in a way you never dreamed possible in a truck. You can ride in it comfortably or drive it easily and without strain at full speed.

Its engine is properly and amply cooled—carries 2½ gallons of water and the water jackets are designed to properly cool valve seats where heat is greatest. Motor meter is seated in radiator shell and cannot be removed.

Complete electric equipment—that means starter too—so your driver won't mind shutting off the motor while truck is standing.

Easiest motor to take down you ever saw in a truck.

Large hand holes give easy access to valve chambers and man size bolts make handling easy.

Lubricating oil is strained twice in its circuit. Scientific hot spot breaks up wet drops into dry gas and makes even the present day gasoline develop full power.

Radiator mounted on patented spring suspension which prevents damage to core and eliminates the great source of leakage.

Standard tread—goes anywhere a passenger car can go and just as fast.

See it for yourself. It is a big, strong, rugged truck—will give you better service than you have ever known.

Any demonstration you want—it's a business truck and will do its work on a business basis. See your Duplex dealer—do it now—he will make the Limited prove itself to you as it is proving itself daily in the hands of users.

"Duplex Doings"—the Truck Users' Magazine, sent *free* to any truck user. Tear off a corner of this page, sign your name and we will put you on the regular list.

Duplex Truck Company

Lansing · Michigan

One of the Oldest and Most Successful Truck Companies in America

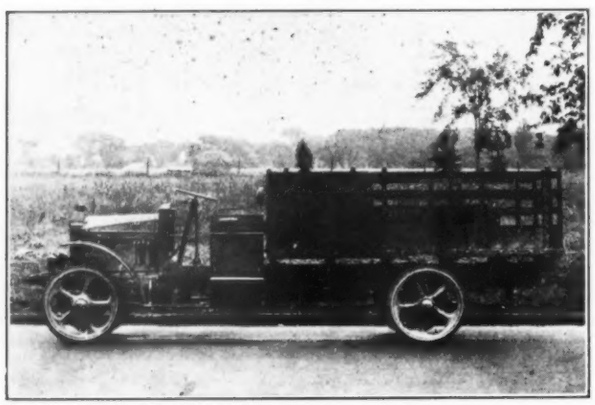
purchase of a truck of proven efficiency ought to be encouraged by bankers generally by proper extension of credit where it is applied for, and with the same liberality with which credit is granted to purchase other tools and equipment. Even in these days when bankers are urged to restrict credits to the essentials, asistance in the purchase of motor trucks can reasonably be granted as the motor truck is one of the essentials. All customers of ours who have supplied themselves with the proper truck have found it a profitable thing."

The Vice President of The Northern National Bank of Toledo, Ohio, said, in part:

"The usefulness of the truck was brought home to us as never before during the recent railway strike, and many of Toledo's industries would have had to close had it not been for the fact that they were able to get needed material through by using trucks. Local transportation is depending more and more upon trucks and horses are seldom seen upon our streets. We do not think it would be possible to replace trucks with horses even if it was thought desirable to do so. Transportation being one of the most vital problems we have before us today, the utility of the truck will be more appreciated, and it is our personal opinion that there is no danger of your business being looked upon as a nonessential industry."

New Pierce-Arrow Dual-Valve Trucks

Announcement of an expanded line of motor trucks, powered by Dual Valve engines, is made by the Pierce-Arrow Motor Company of Buffalo, N. Y. The new line



VIEW OF NEW PIERCE-ARROW 5-TON DUAL VALVE TRUCK.

includes 5-ton, 3½-ton and 2-ton trucks and a tractor unit, each equipped with double ignition and electric lights.

The Dual-Valve power plants which distinguish the advanced design are declared to effect as great a forward stride in motor truck performance as did the introduction of the worm gear, pioneered by Pierce-Arrow in 1910.

"The Dual-Valve engines equip the trucks with a pulling power superior to any demand," said Robert O. Patten, truck sales manager of the company. "Moreover, this power is obtained with an increase in economy; gasoline yields more miles per gallon."

The dual-valve engine, constructed on the principal of the Dual-Valve engine developed by Pierce-arrow engineers so successfully in passenger car use, has been in process of design and test for more than two years. Extended usage under actual working conditions has eliminated all guess-work as to what its performance is.

Adherence to the basic Pierce-Arrow engineering principles, the company states, insures that the present line retains the distinctive characteristics of reliability and durability. But with the refinement of design, the new trucks not only set new performance standards, but establish a record low level of repair and maintenance costs. This is achieved through an accessibility which permits of quick, economical repairs, insuring a minimum of time lost in the service shop and a minimum of repair costs, according to the company's statement.

Modernized manufacturing methods combined with an expansion of factory facilities necessitated by efficient war production methods has enabled the Pierce-Arrow company to enhance the quality upon which Pierce-Arrow reputation has been built. More accurate machining, an even greater uniformity of product and improved methods of testing have achieved the result.

Diamond T Trucks on Tennessee Road Work

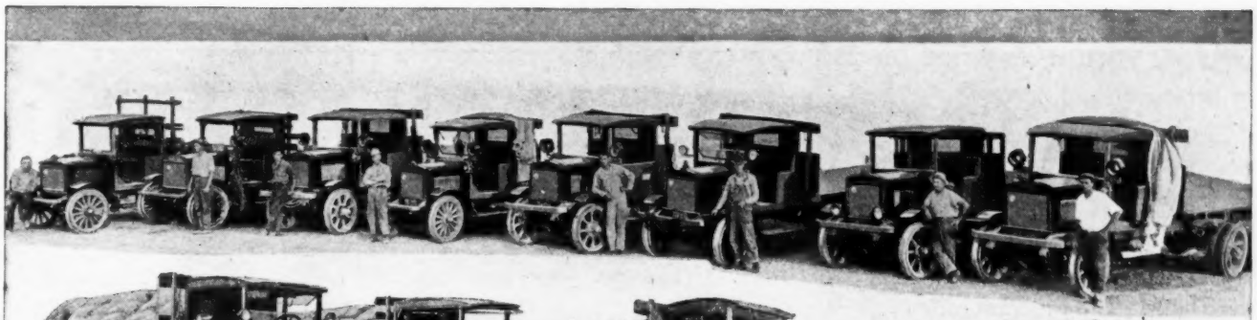
Excavating and fill work on a new road grade through very difficult bottom land and along a level between Memphis and Millington, Tenn., is now being carried on by the Tennalark Transportation Co. with the aid of their fleet of Diamond T dump trucks. The facts and figures which follow are particularly interesting to users of trucks on road construction work, as reported in the Diamond T Accelerator.

The trucks are equipped with steel dump bodies, Type W-3, and Woods Hydraulic Hoists. Their average haul of gravel and dirt is from the steam shovel to the fills or dump located about three-quarters of a mile away. Their average load is 3½ yds. of excavated material weighing approximately 2,500 lbs. to the yard or a total load of 8,700 lbs. Each truck travels 40 miles per day and makes over 26½ trips. As each carries a load of at least 3½ yds. each trip, therefore each truck carries over 93 yds. per day, or a total of 744 yds. of material for the eight trucks per day.

Operating costs per truck obtained from the Tennalark Transportation Company are as follows: fixed charges $7.85 per day and variable charges $12.80 per day—making a total operating cost per day of $20.65 or $0.516 per mile. These figures include a daily depreciation charge of 15 cts., which is unusually high as this company figures only 35,000 miles as the life of each truck. On this basis a truck would be useful only 875 working days (at 40 miles per day), while in reality they will give excellent service for at least five years or more, even under these severe conditions.

Mr. R. B. Stuart, chief engineer, in charge of the trucks, writes as follows: "We feel that these 3½ ton trucks are giving us very high performance at an operating cost which is low for the sort of work in which we use them. Their heavy frame construction and flexible drive enables them to perform consistently under conditions which are severe and which we know to be most exacting on trucks.

"We have had considerable experience in road work and other construction work using heavy duty trucks and our experience shows us that in the Diamond T truck, equipped with steel body and hoist, we have a trans-



KISSEL

Engineering Achievements

designed, constructed and built at the Kissel factories for specific truck power and performance requirements

Surmount Transportation Obstacles

For instance — in the Imperial Valley, 119 ft. below sea level, with thermometer 130° to 135° in the sun, and roads of sandy silt, 15 Kissels, equipped with the Kissel-built motor, cooling system and other exclusive Kissel features, are working 15 to 18 hours a day.

Such dependability is due to concentrated engineering and construction efforts along specific lines, plus Kissel factory facilities, organization and 14 years' truck-building experience.

Kissel distributor transportation-engineers located in all principal cities.

Kissel Motor Car Co., Hartford, Wis., U. S. A.

Originators of the ALL-YEAR Truck Cab.

"Loading the famous Imperial Valley cantaloupes 119 ft. below sea level with temperature 112° in the shade, 130 to 135° in the sun. During the cantaloupe season these trucks work 18 hours a day. No paved streets, but roads of silt deposits from the Colorado river."

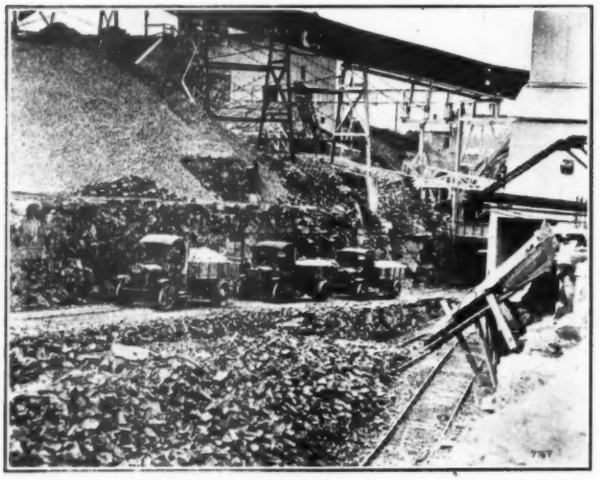
portation unit which can not be excelled for moving excavated material surely and cheaply."

How Onondaga County, N. Y., Uses Trucks

In this motor truck section for May, 1920, some facts were given on the use of trucks of this county and the following additional information is now available:

Back in 1911 the Board of Supervisors of Onondaga County, New York, began an intensive road building program. In eight years, 145 miles of improved roads were built. The program calls for 50 additional miles of improvements during 1920.

The extensive building program determined upon, one of the first big problems in the path of progress was the necessity for installing hauling equipment capable of keeping the stone moving and the dirt flying, in other words,



THREE IN A FLEET OF 19 WHITE TRUCKS OWNED AND OPERATED ON ROAD WORK BY ONONDAGA COUNTY, N. Y.

trucks that could be depended upon to maintain the uninterrupted service so essential to the progress of the road builders. The wisdom of an early disposal of the hauling problem became apparent in 1918, when a lack of freight cars threatened to hamper the road department. On the recommendation of the county superintendent, five more White 5-ton dump trucks were purchased. These were used in conveying material directly from the county-owned Jamesville limestone quarries, located practically in the center of Onondaga County, to the jobs.

From the Jamesville quarries an average of more than 20,000 tons of stone are transported each year to the roads of the county. Often deliveries must be made to roads close to the county line, 20 miles from the quarries to the north and west, 13 miles on the south, and 8 miles on the east. Trucks on this work average 70 miles a day throughout the season. The mileage of trucks on the longer hauls often mounts to 90 for the day.

From a single ¾-ton unit in 1914, the fleet of White trucks owned by Onondaga County has mounted to 19, of which number 14 are used by the road department. Ten of the 14 trucks engaged in road work are 5-ton dump trucks. The other four are ¾-ton models, used in hauling men, tools and equipment to road jobs, and in repair work.

Truck Covers 7,402 Miles in Intercity Hauling in Six Months

Mr. William Winkler, of Chicago, has, for the last two years, been making regular suburban hauls for the Steele Wedeles Co., Wholesale Grocers, of Chicago.

He has kept an accurate record of the cost of his trucking, using as a basis the forms of the National Standard Truck Cost System. The results that he has obtained are interesting.

The truck is a 2-ton Service, bought in the summer of 1918. During the six months from July 1, 1919, to Jan. 1, 1920, it covered a total of 7,402 miles; operating 153 working days out of a possible 154.

This truck makes regular daily deliveries to retail stores in South Chicago, Homewood and Hammond and then returns to the wholesale house. The roads are always good.

Its usual load is boxed goods for the retail trade. It makes 30 stops on the trip, frequently getting back in time to make a short haul in the loop. The average run in 48.39 miles a day.

Formerly these goods were shipped by express or freight, but when cartage at both ends, crating charges and other factors are taken into consideration, it is evident that motor truck service is by far the cheaper method—the time saved is a big factor.

The Steele-Wedeles Company is making quicker deliveries than those who still ship by express or freight. Quick delivery means more rapid turn-over by the grocers with increased profit; which in turn has materially helped the Steele-Wedeles Company to increase its business in these communities.

Are Motor Vehicles a Luxury?

An answer to this question is contained in a recent press bulletin issued by the Chamber of Commerce of the United States: "Any complete point of 'saturation' in automobiles does not seem imminent—rather in a moderate way, a readjustment which has long been looked for. Not only will there be a demand for replacement but also for new purchasers, for we are fast realizing that automobiles are a necessary and inalienable factor in morern civilization. Any talk about their being luxuries and unessentials is rather unknowing and foolish. There was once the same talk about telephones and the telegraph. Outside the definite part which automobiles play in business, and which steadily grows in importance, they have done more to broaden the understanding and the mental horizon of their users than any invention within a generation. In especial they have been a boon, beyond comparison, to the dweller on the countryside—on the farm and in the small town. Of a once popular sport, that of bicycling, now relegated altogether to strictly useful purposes, it is interesting to learn that the annual output is now much in excess of the days when they were a passing craze."

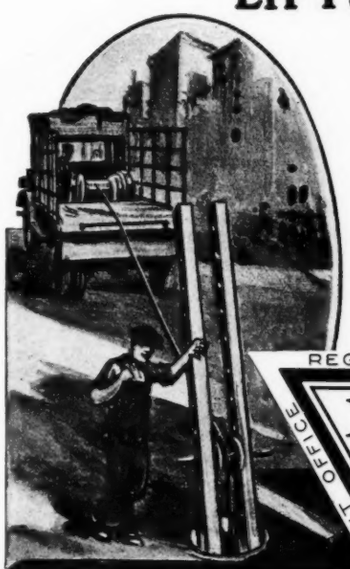
EFFICIENT DISTRIBUTION OF SHORT HAUL PRODUCTS

(By J. F. Bowman, General Sales Manager, The Garford Motor Truck Co.)

Whether it be in street car, subway, parlor car, elevator, office or home, there is that perpetual appeal: "Give us more transportation." We need transportation. How well we know and realize it.

MEAD-MORRISON SERVICE

LIFTS THE LOAD OF INDUSTRY

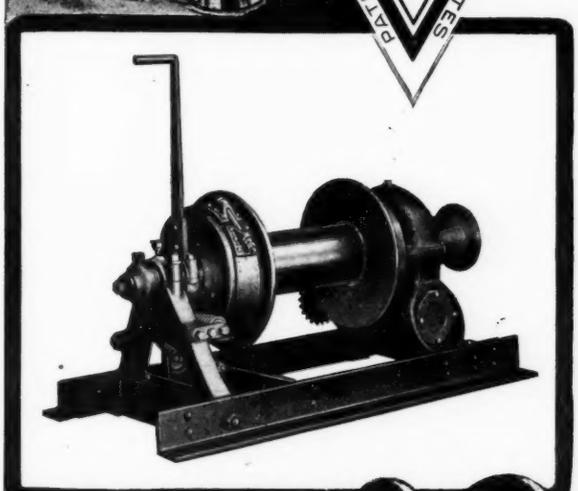


More productive hours! Two hours a day—for each man on the truck and the truck itself—over 600 hours a year for each —over 1800 hours when the truck carries two men.

Such is the demonstrated achievement of Mead-Morrison Engineers, proving indisputably that the ideal of Mead-Morrison—to increase the productive hours of industry—is being carried out in a sound, practical way in

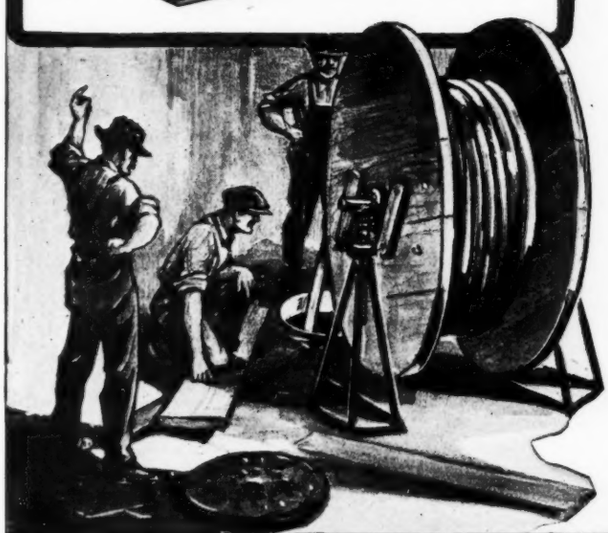
REGISTERED IN UNITED STATES PATENT OFFICE MM CM

MEAD-MORRISON Truck Winch



Both types of Mead-Morrison Winches, the Vertical Capstan and the Friction Drum, have thoroughly demonstrated their practical worth in reducing costs in handling heavy, bulky loads. The Friction Drum Winch, shown pulling telephone cable through the conduit, is but another illustration of its worth in reducing costs on the "out-of-the-ordinary" job. In this case it actually released five men for other work, and with fewer men made a 50% increase in the amount of cable installed.

The Mead-Morrison Motor Truck Winch Folder conclusively proves there is a real saving when you "let the engine do the work." Send for one.



—TRUCK WINCH DISTRIBUTORS—

Auto Truck Equipment Co.,	Pittsburgh, Pa.
Edward R. Bacon,	San Francisco, Cal.
Horizontal Hoist Co.,	Chicago, Ill.
Hummel Mfg. Co.,	St. Louis, Mo.
Interboro Hoist & Body Co.,	Brooklyn, N. Y.
Kunkel Wagon Co.,	Baltimore, Md.
Mansfield Steel Corp..	Detroit, Mich.
Motor Truck Equipment Co.,	Philadelphia, Pa.
William Ogden,	Indianapolis, Ind.
Springfield Commercial Body Co.,	Springfield, Mass.
Springfield Commercial Body Co.,	Cambridge, Mass.
The Truck Engineering Co.,	Cleveland, Ohio.

MEAD-MORRISON
MANUFACTURING COMPANY

926 Prescott Street EAST BOSTON, MASS.

Announcing the PIERCE-ARROW Dual Valve trucks

In a full line including

a 2-ton truck
a 3½-ton truck
a 5-ton truck
and a tractor

with DOUBLE ignition and ELECTRIC lights.

They mark as notable an advance as the Wòrm Gear, introduced by Pierce-Arrow in 1910, which has become the dominant means of truck propulsion.

The adoption of the Dual Valve principle means greatly increased power and surprising operating economy.

THE GREAT EXPANSION of facilities and the efficient organization necessitated by War production developed invaluable experience enabling us to enhance the high quality which always has marked Pierce-Arrow.

THE PRESENT LINE *retains* these distinctive Pierce-Arrow characteristics—durability, long life, easy operation.

It *gains materially* in these vitally important attributes:

Pulling Power—equal to any demand

Gasoline Economy—more miles per gallon

Accessibility—for quick economical repairs

THESE ARE PRIMARY FACTORS in operation and maintenance—the true test of truck economy.

Pierce Arrow

48 of the FIRST FIFTY trucks still running after 9 years' service.

Delivers more work in a given time.

Loses less time on the job and off the job.

Costs less to operate and less to maintain.

Lasts longer, depreciates less, commands a higher resale price.

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

GARFORD

Economy—the order of the day in all business —has been the outstanding advantage of Garford Trucks for the past twelve years. ***Low Cost Ton-Mile*** is the one real basis of true haulage economy.

Garford

Lima, Ohio

Returns from an investigation among several thousand Garford owners show 97.6% are 100% satisfied.

TRUCKS

Like sheep we are prone to follow those in our midst, around us, and of whom we read. Too often we lack originality and initiative. In proof of this statement some months ago "mass production" was on the minds, lips and ears of everyone. We could see nothing but men, material, machinery, results. Some far-seeing individual rocketed transportation and everyone thought in terms of "length of time on the road," and now—men are idle, material is not forthcoming, the hum of machinery is diminishing and, as for results, well, we all know about that!

"Distribution" is wending its way into everyday conversation; in it we have the real meat of the matter.

Transportation — Distribution — there is the whole thought.

Highway Freight Terminals Will Reduce Food Prices

In these days when we hear and see so much we live in an era of "free education." We realize as we never did before how cause precedes effect—there are reasons for every result.

We have reached the school grade that teaches: "Motor trucks for short hauls!" We start out; and herald the glad tidings: "Ship by Truck!" Do we stop to think what effect this cause will have? Do we realize that if everyone were to decide at one time to "Ship by Truck" how the traffic congestion of our largest cities would look? And our highways! They would become veritable trains and fleets of trucks bound for city markets of all kinds.

Now, we see where distribution takes us a step further into this subject: "How" and "where" are we going to distribute short haul products? These are the obstacles to the short haul.

As the railroads have freight yards, so shall the motor trucks have terminals—they must have terminals. Railroads do not want short haul loads; they cannot handle them efficiently.

A striking example comes to my notice as I write this: Newark is only about 10 miles from New York City, yet the gross charge of shipping 100 lbs. of freight from New York City, including teaming charges from both ends, is 91 cts. by railroad, and may take about three days. The same load can be handled by truck for 15 cts. and only takes a few hours. Such an example is typical of all our large cities.

The question of terminals is of domestic and municipal importance. The New York "World" published an article recently in which it stated that terminals or markets in New York City alone would save the consuming public $150,000,000 per year in truckage and wastage of food stuffs, and that the city would be able to net 12 per cent. per year from rental on its investments. Such figures are astounding; yet they are unquestionably true.

Agriculture is the barometer of America; then, produce! But, if that which is produced is allowed to rot—to waste, why produce? Delays of about three days from a country station to a city market, a distance of about ten miles, would certainly answer the oft-repeated question: "Why do good eggs go wrong?"

Several months ago the magazine "System" published a good story—so good we believe we can make mention of it: Two shipments of eggs and one-day old chicks were started at the same time from Lancaster for New York, 180 miles away. One went by truck, one by rail. The truck delivered the order in 12 hours, with a loss of

4 chicks and 9 eggs. The rail shipment reached the consignee in 5 days, losing 500 chicks and 1,000 eggs. It is such losses as these that cost New York City $150,000,000 yearly; it is such a service by motor trucks through terminals that would save the city that much.

What applies in the East will apply in the other sections of the country. Plans have been submitted to the city of New York for five city markets to cost $80,000,000 and if the city will not build, financiers will do so. Merchants and consumers alike realize the possibilities in "transportation by motor truck."

It was only the other day that I was told that the shipping merchants of one of our largest cities had relief of terminal congestion. At many railroad freight terminals trucks stand in line as long as 42 hours awaiting "cargo." Is that efficiency? And we wonder why we have to pay, pay more!

Motor Truck Staunch Ally of Railroad

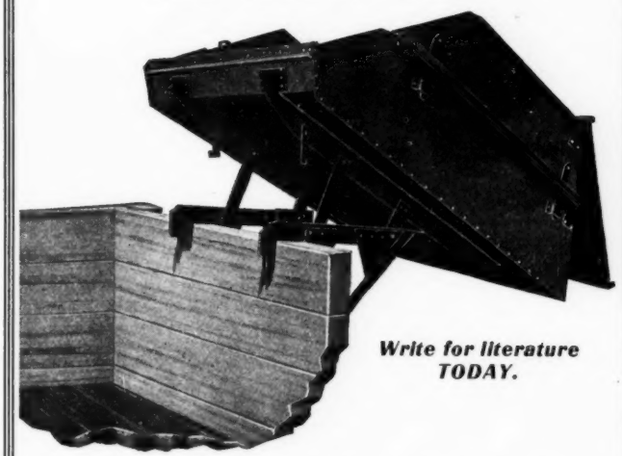
Motor trucks are not "knocking" the railroads, neither do the railroads reject motor trucks, on the contrary, they welcome them. But, let us not forget that when we talk "Ship by Truck," "Motor Trucks for Short Hauls," and "Good Roads for Motor Trucks," that we must have depots, terminals and "highway freight yards" in our cities for the distribution of food at a living price, and through which "short haul traffic" can make connections for other points.

Mass Production, with quantity transportation and efficient distribution of short haul products through "highway freight terminals" will solve many of our national economic ills.

Mr. Dan Tankersley, Sapulpa, Okla., wired **"Heltzel 'Lightning' Loader Skips giving perfect satisfaction."**

The ever increasing number of satisfied buyers prove the **"Lightning"** Loader Skip is a necessary piece of equipment for unloading open cars.

$60.00, 1 cubic yard size
70.00, 1½ cubic yard size



Write for literature TODAY.

The Heltzel Steel Form & Iron Co.
WARREN, OHIO.

ACME

—We Made the Grade and Won Out.

"We were taking out of that pit about 150 yards a day as it was a short haul. We made the grade with a four-yard load. My truck at this time was the only hired truck, all others were laid off. They could not make the grade. It was a hard test and we won out."

The above is an extract from the letter of J. A. Plummer, of Hopkins, Minnesota. He goes on to state that it would take seven teams to do the work that the 3½ ton Acme is doing and would cost four times as much.

Contractors and engineers have learned the merits of Acme trucks. The strenuous service conditions that usually obtain in engineering work call for trucks of exceptional power and stamina. Here indeed does the principle of "proved units—Acme constructed" win recognition.

Write for complete information on Acme service in contracting and engineering work. A recent survey will prove very interesting to all engaged in construction work.

ACME MOTOR TRUCK COMPANY
317 Mitchell Street **Cadillac, Michigan**

Seal of Dependable Performance

ACME THE TRUCK OF PROVED UNITS

Trade Mark Registered U. S. ann other Countries

HAUL IT IN A HALL

Hall Trucks are the development of forty-six years' experience in the fabricating and transportation of structural steel

No other truck, perhaps, ever grew out of such wide knowledge and practical experience as Hall.

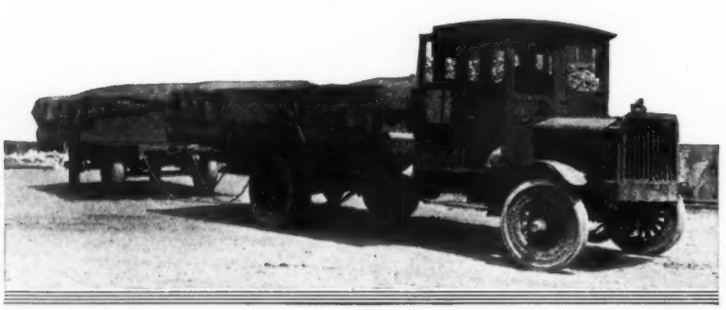
Hall Trucks, as you may know, have an unusual service record back of them—a record that dates back to their use by the French and American armies in the World War.

Their war service attracted the attention of truck users here in America and resulted in a steadily increasing demand for Hall Trucks from all over America.

The completion of our new four-acre factory has increased our capacity to 500 Hall Trucks per month. Write for catalogue and full particulars of our liberal selling agreement.

2½, 3½, 5 and 5 to 7 ton Models. Any type of body.
See nearest Hall dealer or write for catalogue.

LEWIS-HALL MOTORS CORPORATION
DETROIT, MICHIGAN
Formerly Motor Truck Division of the Lewis-Hall Iron Works
Address Dept. 23



HALL TRUCKS

EDITORIALS

WANTED: SOME HORRIBLE EXAMPLES

What can be done to impress upon the public the importance of employing engineers to do engineering work? Much has been done and still more can be done through engineering journals which are read to some slight degree by non-technical city officials. Also, by furnishing engineers with specific examples showing the folly of entrusting engineering work to the uninformed it is likely the engineers will be able, in some cases, to safeguard their interests. But this is all insufficient. The people must be reached directly. How shall it be done? Our answer is: through the popular magazines.

We are glad to have among our acquaintances a clever man who has for years made a specialty of writing popular articles on engineering subjects. And he has been very successful in getting his articles printed in the popular magazines of large circulation. We suggested that he prepare articles on: An Engineer for an Engineering Job, and offer them for publication in popular magazines. He has consented to undertake the work.

What direction shall the presentations take? Argument, unless concealed, is distasteful. This generation argued itself down to a whisper before and during the war. Preachments are also out of date; the populace is, for the time being, fed up on preaching of all kinds, if we mistake not. The appeal must be elemental. As the average patriot is interested only in being warm, dry (outside), well-fed and entertained we must pin our hopes to entertainment. We must give him some interesting stories and in reading these he must get the point without suspecting that an effort is being made to instruct him.

Now, in glancing over the popular magazines of the day, it seems to be the prevailing style in composition to alternate anecdote and application. The title may or may not contain an obvious play on words, though this is highly desirable for purposes of regularity, but it is absolutely essential that the article begin with an interesting anecdote. Follow with a short application, not so long as to bore the reader or to arouse his suspicion that an effort is being made to tell him something, and then swing easily into another simple narrative, follow with the application, etc., etc.

We have undertaken to furnish some horrible examples of the employment of the unfit and we ask the co-operation of our readers. Undoubtedly every engineer has at least one anecdote to tell. Let us have it and we shall pass it on to the popular writer who will not mention names and places, as it is not the object of this work to hold any individual up to ridicule or to reflect discredit on any locality, but to drive home some truths of general interest, ignorance of which is making trouble for taxpayers and is costing them good money.

THE TIME ELEMENT IN ENGINEERING LITERATURE

The time element, unfortunately, often operates to curtail the production of engineering literature and also to reduce its usefulness. More often than not when engineers are asked by editors or society secretaries for a professional paper on a project in hand the invitation is declined because of lack of time. Sometimes engineers are too busy to write, and this fact is fully appreciated, but we are convinced from years of editorial experience that where too much is not attempted the preparation of a useful engineering article is a simple and pleasant task. Some articles require a long time in preparation but articles of that type are not in the majority. Such articles are those involving theoretical discussion, necessitating much study, and those in which there are elaborate compilations of data. But the great majority of engineering articles relate to specific projects. It should be as easy for the engineer in charge of a project to describe it as to recount the events in his life. To him it is a simple story, easily told, if he does not insist on making hard work of it.

Perhaps the most useful type of article at this time is the one describing the construction methods and equipment employed on a job. To the engineer in charge this is, or should be, easy. If he will but outline the salient features of the work on the back of a calling card and then call in his stenographer and dictate the story as it comes quickly to his mind, the composition is soon roughed out. Running the pencil over the typed statement straightens out the structure of the composition and the job is finished. Prompt publication is easily secured and the profession has a bit of current experience for its guidance. This is every bit as easy as it sounds. The dictated article is likely to be most useful, not at all because it is dictated but because it comes from a man who probably wouldn't find, or take, time to write in any other way. It is obvious that the most helpful articles are the ones from men who are doing things. They may be too busy to write out in longhand an elaborate article, but they are not too busy to dictate a short one. Engineering literature needs the dictated, short article. It is well to point out that in dictating the features that come to mind are the

important ones, of greatest general interest, while trivialities of local interest do not come readily to mind and are not included.

The old way to write an article on a specific project was to wait until after the job was finished before beginning. Then the history of the project was recorded in detail, including the legal and financial disorders of its infancy, but omitting the very points that troubled the engineer from day to day. Invariably these are the points of interest to other engineers and are the ones most likely to be included in a dictated article. We hope engineers will agree that the dictated, short article on the projects of which they have charge are easily possible and well worth while.

ALDERMAN ADVISES ENGINEERS TO MAINTAIN LOBBY

A Chicago alderman recently addressed the Chicago Chapter of the American Association of Engineers and offered some practical advice with respect to the influence of politics on engineers. In substance, he advised the engineers to get into the game, not only in self-defense, but as a public service. While there are many fine engineers in the service of the city of Chicago, there are some men in charge of minor engineering work who are not engineers at all and got their city positions solely because of their political usefulness, according to the alderman.

After pointing out that many engineering projects are headed by men who know nothing of engineering work, the alderman said: "That is where you ought to start your work; start lobbying and stop this sort of thing, not only in the city hall, but in the county building and down State. Have your men on the job, your so-called 'lobbyists,' and let them get busy. See if you can't succeed in passing a law in the legislature making it mandatory on the Governor, the mayor, the president of the county board, to appoint engineers. Do this so we won't have to go and pick up real engineers on the outside in our dealings with the public utilities, spending the taxpayers' money twice when it need only be spent once. When the State legislature is in session you should have a man down there watching every move pertaining to engineering. When your man is through there he should come to the city hall, covering the city hall as regards engineering. It should be done."

The alderman offered to introduce a suitable ordinance in the city council in line with his suggestions.

The word "lobby" may frighten many high-minded engineers because of its use, for many years, as an opprobrious epithet. But it describes an established system which is often exercised for the public good. Few measures are put through legislative bodies of any grade without being pushed, hauled and driven through by an interested, energetic lobby.

THE GRAY WOLF DIED POOR

A certain man grew old in the service of his city. He served as a prominent member of the city council for a period as long as the span of the average life. He was a man of courage and of positive convictions and made strong friends and bitter enemies. His party politics did not agree with that of the powerful newspapers of his city. They opposed him habitually. They called him a "gray wolf" and created the impression among the people, who depend for their information entirely upon the newspapers, that he profited greatly in deals with private interests at the expense of the city. It was held that he systematically prostituted his office for his own gain. Many people considered this man wealthy. They loathed him for his unclean money.

When he died it was established in the probate court that his estate amounted to only seven thousand dollars, in these days a small estate for even an honest man to leave. And this modest estate consisted of a four thousand dollar equity in a small home, which he was paying for in installments, and the balance consisted of house furnishings, and other necessary personal property, and a pitifully small sum of money in bank. And so the truth came out. He wasn't a "gray wolf" at all; just a poor, old man who lived and died in the service of his city.

And what did the newspapers say? They did not entirely suppress the news of his penury; it was told in a few lines of type inserted near the bottom of a page near the middle of the paper. While he lived, front page columns and seven column heads were used to tell of his alleged dishonesty. These were read and are probably remembered. Only careful readers would note the short and simple evidence of his honesty published after his death.

The newspapers, as assassins of character, are the greatest enemies of good government, whether municipal, state or federal. They use language for the concealment of thought, to becloud all issues, to muddy the sources of information. Until we have clean newspapers we must expect that many men will decline publice service. A great lawyer once said: "Serve the corporations well and they will pay you well; serve the people well and they will crucify you." How often has the truth of that statement been demonstrated! As long as the newspapers defame our public men and are believed by the people we can scarcely expect good government. The wonder is that public officials will serve at all.

There is less of the milk of human kindness in the treatment of public officials today, by newspapers of the political opposition, than was contained in the sponge of vinegar held up to the cross almost two thousand years ago.

Novel Construction Methods Employed on Morris-Ottawa, Illinois Concrete Road

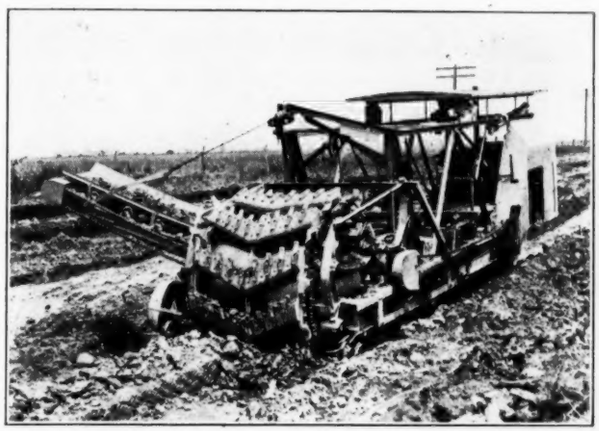
By J. E. Huber, District Engineer, Illinois Division of Highways, New Clifton Hotel Building, Ottawa, Ill.

The construction of the Federal Aid Road between Morris and Ottawa, Illinois, which is a part of the Chicago-St. Louis road, has brought out some novel construction methods. The R. F. Conway Company of Chicago has the contract, consisting of 21 miles of Portland cement concrete pavement 18 ft. in width. Directly west of Morris for a distance of eight miles the road passes through gently rolling country but for the remaining distance the route follows the north bluff of the Illinois River Valley overlooking both the river and the Illinois-Michigan Canal. When completed this will be one of the most beautiful drives on the proposed system of improved highways in Illinois.

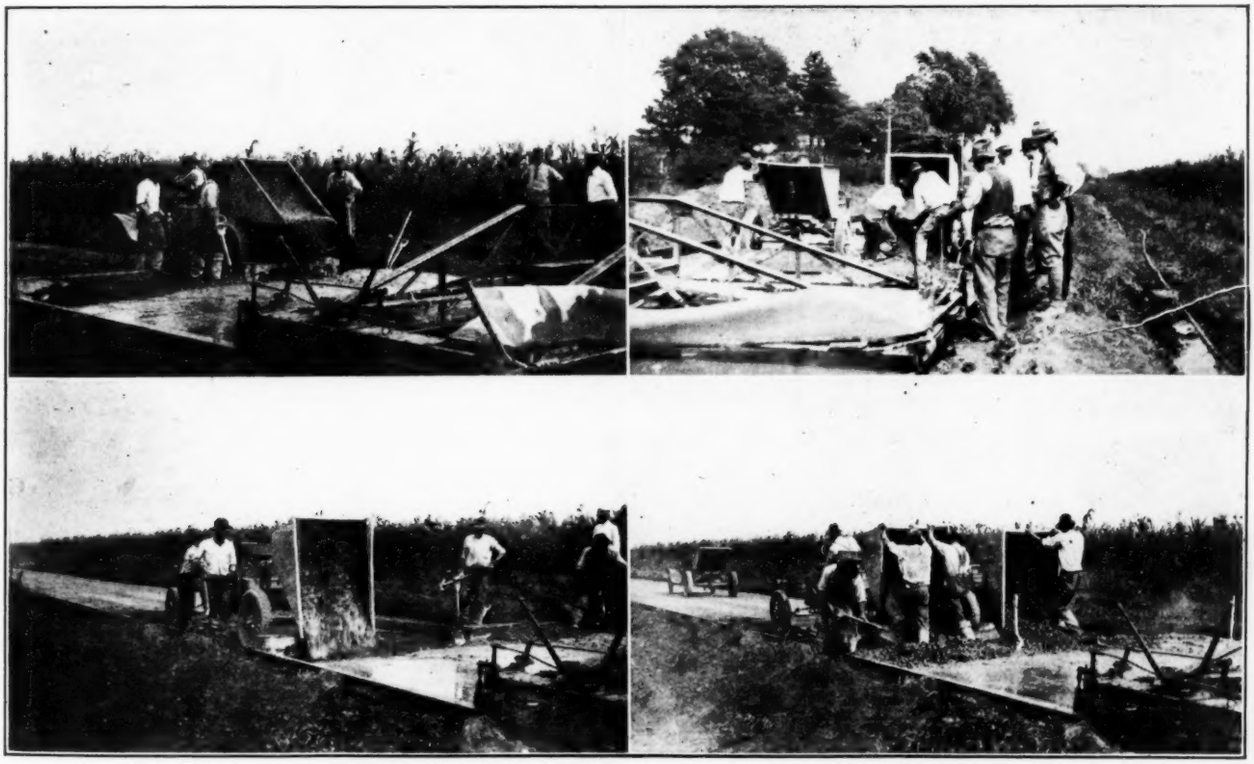
The old road along the bluff was very narrow and winding and its improvement required considerable heavy grading in widening and re-locating portions of the road to eliminate dangerous turns. Along quite a distance a special road section is being used which provides a curb along the up-hill side and an earth shoulder 8 to 10 ft. wide on the opposite side, instead of the standard section which provides a 6-ft. earth shoulder and ditch on both sides of the pavement. Special attention has been given to the design of the culverts and bridges at the numerous ravines crossing the road, in the way of providing drop boxes and inlets to collect the water falling upon the road surface.

Specially Constructed Excavator

The heavy excavation is being done with a specially constructed machine designed by the contractor. The accompanying illustration shows the principal features of the machine, its operation being quite similar to that of an elevating grader, though it cuts for a width of 5 ft. 6 ins. to a maximum depth of 18 ins. It is equipped with



VIEW OF SPECIALLY CONSTRUCTED EXCAVATOR USED IN GRADING FOR MORRIS-OTTAWA (ILL.) CONCRETE ROAD.



VIEWS SHOWING LIGHT TRUCKS DUMPING MIXED CONCRETE ON SUB-GRADE OF MORRIS-OTTAWA ROAD. FINISHING MACHINE AND SIDE FORMS ALSO SHOWN.

VIEWS OF CENTRAL CONCRETE MIXING PLANT ON MORRIS-OTTAWA (ILL.) CONCRETE ROAD JOB SHOWING LIGHT TRUCKS EQUIPPED WITH END-DUMP STEEL BODIES BEING LOADED DIRECT FROM KOEHRING MIXERS.

a caterpillar traction and its power is furnished by a large gas engine. This machine handles macadam and compacted gravel easily and under favorable conditions it is reported to have excavated over 4,000 cu. yds. of material in a day.

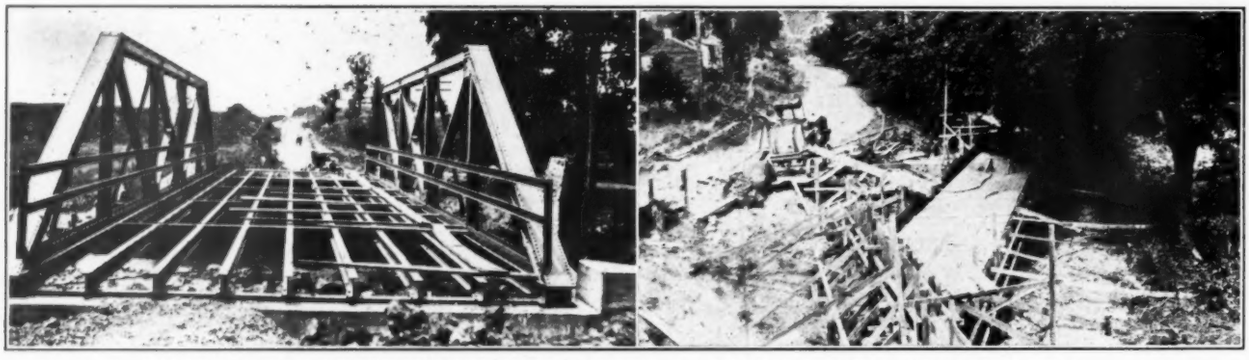
Use of Central Mixing Plants

The concrete for the pavement is mixed at central plants located at convenient railroad sidings, and is delivered on the road by Ford trucks equipped with Lee end-dump steel bodies. At the central plant gravel and sand are unloaded from railroad cars by a locomotive crane and dropped in large piles on a long tunnel about 7 ft. square, constructed of steel and heavy timbers. Trap doors are so located in the roof of the tunnel that a number of industrial cars can be loaded with the correct proportions of sand and gravel. The cars are then pulled by a small industrial locomotive past the cement storage shed and switched to a track which runs close by two large Koehring concrete mixers. The grade of the tracks on which the industrial cars operate is planned so that after the cars discharge their contents into the mixer hoppers they return to the tunnel by gravity, thereby making it possible to operate two trains continuously with one locomotive.

Mixed Concrete Hauled in Trucks

Concrete is discharged from the mixers direct into the trucks, a load consisting of a four sack batch mixed in the proportions of 1—2—3½. The truck bodies are designed so that practically the entire load is carried on the rear axle. The trucks are equipped with large pneumatic tires and are able to maintain a speed of approximately 12 miles per hour when loaded over ordinary earth roads.

When paving work started on this contract the mixed concrete was hauled 4.6 miles yet no difficulty was en-



BRIDGE AND CULVERT CONSTRUCTION VIEWS ON MORRIS-OTTAWA (ILL.) HIGHWAY.
Left: Type of Steel Bridge Used Where Concrete Structures are not Practical. Right: Large Skew Culvert on One of Many Relocations.

VIEWS SHOWING RELOCATION TO ELIMINATE DANGEROUS TURN AND STEEP HILL WHERE ROAD LEAVES A BLUFF ON THE MORRIS-OTTAWA HIGHWAY.

countered in handling the concrete dumped from the trucks onto the subgrade. Concrete mixed fairly dry and plastic is much easier to handle in this way than wet concrete, due to the separation of the mortar and coarse aggregate in wet concrete during the hauling. At first some difficulty was experienced in getting the concrete to dump cleanly out of some of the trucks due to the rough, rusty surfaces of the bodies, but this trouble was quickly overcome by providing these bodies with loose false bottoms of rubberoid roofing material.

After the concrete is dumped on the subgrade it is struck off, tamped and belted with a machine especially built for this purpose which uses the steel side forms for its track. The concrete delivered in this manner is no more difficult to tamp and finish than concrete mixed to the dry consistency required by the Illinois Division of Highways specifications and discharged directly from the mixer on the subgrade, and as this system operates satisfactorily on a haul considerably longer than the average haul on most country road work it is believed the adoption of this scheme will meet with success on a large number of road contracts.

FOUNDATIONS FOR ASPHALTIC PAVEMENTS

By John C. Wilson, Inspector of Pavements, City Hall, Pocatello, Idaho

Conditions resulting from heavy motor-truck traffic are accentuating the necessity of many changes in established construction methods, even so far as to bring under question the sufficiency of the usual type of foundation.

Experiments, tests, and recent articles written in the technical press have directed attention toward the possibility of employing other materials besides Portland cement concrete, and have shown the effect of modern loads in wrecking foundations.

During the war, in the summer of 1918, in Chicago, two weeks of unusually heavy motor traffic upon a perfectly good asphalt pavement smashed the 5-in. Portland cement concrete foundation, with attendant and inevitable injury to the surface.

The question is asked "Why?" and is answered in a few words: "Because Portland cement concrete has no modulus."

The earth or subgrade is the ultimate support of any pavement and Portland cement concrete has a slight advantage over less rigid types of foundation in only one instance, in maintaining an even contour, but is only efficient to its maximum load limit; the relative rigidity of Portland cement concrete gives it a low shock absorbing ability, and pavements not only must support dead-load, but must resist the smashing impact of traffic.

When Portland cement concrete is used as a foundation for bituminous top, this unyielding rigidity causes it to act as an anvil, necessitating the absorption of shock, due to heavy traffic, by the wearing surface, concentrating the full effect of smashing blows on this thin layer.

The last four years have seen an increase in the price of Portland cement which is adding to the usual cost of pavement construction a sum sufficient to give considerable concern; and while public officials may feel they are justified in paying the increased price, nevertheless it might be well to consider whether Portland cement concrete is the proper material for foundation for asphaltic surfaces.

For many years the writer has closely observed the behavior of Portland cement concrete foundations and has come to the conclusion that there are other and more efficient types of foundation that can be constructed at less cost.

Bituminous-Concrete Foundations for Bituminous Surfaces

The use of bituminous-concrete foundations for bituminous surfaces is not a new experiment, in fact, it is very widely employed. Sections laid upwards of 20 and 30 years ago are still giving excellent service in Washington, D. C.; Portland, Ore.; Los Angeles, Visalia, Calif.; Omaha, Neb.; Pittsburgh, Pa.; Denver, Col., and elsewhere. It is the opinion of the writer that study along these lines, particularly in the light of today's conditions, and experiments and tests of the last three years, will disclose that it has many virtues which are lacking in the less yielding Portland cement concrete.

Experience has shown that bituminous wearing surfaces themselves can easily withstand the heavy traffic of the larger cities. Chemical and physical methods of mixture control have developed to a degree that insures the preparation of mixtures capable of successfully withstanding a wide range of climatic and traffic conditions, and it only remains to utilize their virtue in such a way as to obtain their maximum service.

An Asphaltic Base Laid in 1896 Still First Class

I wish to mention one of the early examples of asphaltic concrete base construction in Central California, at Visalia; a pavement laid in 1896 and subjected to continuous mixed traffic of medium intensity. It still is in first-class condition. It originally consisted of a 4-in. base composed of gravel, sand and refined asphalt, all plant-mixed, with a 2-in. wearing surface. Also at San Pedro, Calif., a street leading to Government harbor fortifications, has a pavement composed of 3-in. asphaltic cement base and a 2-in. Warrenite wearing surface. In addition to normal traffic, this street was subjected in 1918 to the hauling of some 30,000 tons of building material for the fortifications, most of which was hauled on 5-ton trucks. Later the 14-in., 60-ton, coast defense guns were hauled over this pavement, which now is in good condition.

The life of a standard asphaltic pavement is seldom limited by the wearing away of its material or by defects inherent in the surface. We have been prone to consider that the only function of a satisfactory foundation for bituminous pavement is to furnish a support for the wearing surface. While it is true that support is essential, it is also true there are many other requirements which should be met, and that aside from the ability rigidly to support loads, Portland cement concrete fails in many ways to supply the conditions which favor the maximum life of a bituminous surface.

Many weaknesses and defects commonly attributed to asphaltic surfaces are the result, directly, or indirectly, of shortcomings of the Portland cement concrete foundation.

If a properly prepared asphaltic wearing surface can be made to hold its shape and is protected from the action of water from below, two of the most common causes of failure will be avoided. This can be solved by an

asphaltic or crushed rock base, properly drained. Thus, it is possible to apply an asphaltic wearing surface to its supporting structure in such a way that the action of these agents are prevented, the most potent forces leading to its destruction are removed, and its average service is greatly increased.

Besides the friction between surfaces in contact, there is no bond between the asphaltic surface and the concrete foundation. Portland cement concrete absorbs moisture from the earth through capillary action. Since a bituminous covering prevents evaporation, the surface of such a foundation is usually moist, providing a condition favorable to disintegration, also destroys the bond which is not integral and due to the effect of traffic shock or thrust produces a horizontal component, and the absence of a positive and integral bond between the wearing surface and foundation becomes, therefore, a source of weakness, and "buckling" results.

Rolled Stone Base

Similarly, there is an abundance of proof, under 5 to 15 years' service in many places, such as Massachusetts, New York, Illinois, Texas, New Mexico, Arizona, Utah, Idaho, Oregon and Washington, that with proper conditions of sub-grade and drainage, compressed stone base (whether old macadam or new construction) affords a superior foundation for stable bituminous surfaces. Such compressed stone base, like asphaltic concrete base, supplies the essential properties of:

(a) Shock absorption.

(b) Unity under compression of base and wearing surface.

With foundation and surfaces, in effect, integral, it is apparent that a most important condition favorable to displacement would not longer exist. Furthermore, it is apparent that a substantial thickness of bituminous concrete will not be so easily affected by temperature changes and will remain cooler in summer and, as a result, more stable under such conditions than will a thin surface.

Also, it may be well at this point to emphasize particularly the effect of the mass and thickness in stabilizing bituminous mixtures. The contact plane between the surface mixture and a rigid Portland cement concrete support, is, as stated before, a seat of weakness. Whether the support is a thin concrete base or the subsoil directly, it becomes important to minimize at this contact plane the intensity of all forces, particularly those tending to lateral movement, which may reach the foundation from the surface. The effect of the thickness of a shock-absorbing medium in distributing and minimizing these forces, should become apparent without further discussion.

NATIONAL CONFERENCE ON ENGINEERING EMPLOYMENT

A national conference on engineering employment sponsored by the American Association of Engineers will be held in Chicago on Nov. 12, 1920. Practically all free employment bureaus will have representatives at this conference. All employment managers of the large industries and employers of technical men will be invited to attend and participate. The object of this conference is to provide a forum for solution of industrial relations problems affecting employers and engineers.

THE UTILIZATION OF MUNICIPAL WASTE

I—The Utilization of Sewage Sludge, with Particular Reference to Experiences at Canton, Ohio.

By William F. Morse, Consulting Sanitary Engineer, 715 Hippodrome Bldg., Cleveland, Ohio

One lesson in economy which was forcefully impressed upon the minds of the people by the war experiences of 1917-1918-1919 is the saving in the minor conditions of household life, meaning the reclamation of substances and articles that heretofore have been thrown away as worthless, that are designated as municipal refuse.

Under the urgent appeals of the federal government for increased conservation in all food products, the transformation of a part of these into substances to be used in war munitions, the reclamation of paper, rags and all matters that could be turned into paper stock, and the general saving of all values known to exist in municipal refuse, there was begun and is being continued a movement in municipal refuse conditions that is now a well defined economic policy for American communities.

Classes of Waste With Recoverable Value

The several classes of municipal waste that have value enough to defray the cost of collection and return some revenue to the towns may thus be stated:

Sewage (Sludge)—In all its forms used for land fertilization.

Garbage—Separately collected, used for stock feeding.

Paper, Rags, Etc.—That can be manufactured into paper stock.

Metals, Glass, Ashes—And other incombustibles.

To these may be added the development of useful heat from the incineration of part or the whole mixed collection. It is proposed to discuss briefly the reclamation of these forms of municipal waste as an economic measure for American municipalities.

Utilization of Sewage Sludge in General

The world has always had in use some form of land fertilization from the excretions of the human body. In the older countries the application is made to the ground directly from the household collection. In modern practice the collected sewage is brought to a point where it is utilized by one or another means or finally disposed of by various forms of treatment.

The economic advantages of sewage farming have long been a debated question. The sight of luxuriant vegetation obtained from land fertilized with sewage, appeals to the imagination and answers the argument that the world requires the return to the soil of matters that can again be used to make the soil more productive. But there are certain limitations that apply in considering sewage fertilization. The area of ground to be treated must correspond to the amount of sewage available in the different forms. The land must be not too far distant from the sewage collection works. There must be steam or electric power for daily use at moderate cost.

When these conditions are duly met and the land is of a character to assimilate and convert the manural properties of the sewage rapidly and without nuisance, then there is no doubt of the economic results. An example of a sewerage installation may be quoted as offering

many advantages for employment of sewage sludge as land fertilizer.

Experiences at Canton, Ohio

In 1914 the City of Canton, Ohio, (population, 1910, 65,000; population now, 80,000) put into service a Sewage Disposal Plant built eight miles south of the city line, comprising an area of about 30 acres along the east bank of the Nimishillen Creek, about ¾ mile long by ½ mile wide.

The works are of the usual type of sedimentation tanks and include screen chambers, grit chambers, six sedimentation tanks of the Imhoff pattern, arranged in two series of three each, sixteen contact filter beds, area ½ acre each, six sludge beds for dewatering sludge, three of these covered with glass for quicker drying, a small pumping plant with steam boiler for general purposes, laboratory building, and equipment for observation record and analysis. There is a brick covering house over the screen and grit chambers with steel stack for ventilation. The boilers, pumps, workshop, are also enclosed in permanent brick building. The plant has a maximum capacity of six million gallons of sewage per day. The present mid-summer flow is 4¼ million gallons.

Early in 1920 the city purchased the farm lands adjoining the sewage treatment plant, comprising about 100 acres of farming ground, including two good dwelling houses, large barn, out buildings, etc., with excellent spring water supply.

The land lies in a half circle around the sewage plant as a center, but on higher ground along the main road. The extreme limits of the ground are about 2,500 feet from the pumping station of the sewage plant.

Up to this time the neighboring farmers have had excellent results from the dried sewage sludge applied to various crops. By employing a "manure spreader," a wagon which has a mechanical attachment for chopping up the sludge and spreading evenly over the ground, the sludge is hauled and spread with a minimum of labor and no initial expense for the fertilizer.

The results of this method are remarkable. A comparison of two fields of equal area sown with wheat at the same time showed an indicated yield of the one fertilized with sludge of upwards of four times the quantity produced by the unfertilized field, and the experience of previous seasons when sludge has been used confirms this estimate by practical returns.

The method of applying the sludge direct to the fields by pumping the liquid from the sludge compartment of the sedimentation tanks through the lines of piping is found to be perfectly practicable. Larger areas of ground can be treated in a shorter time at far less cost and with better results. The permanent line of 2½ in. iron pipe from the pumping station can be run to about the center of the areas lying within a radius of 1,500 to 2,000 feet. This is continued by a line of partly used fire hose shifted as required by one man and controlled by one man at the nozzle. The action of the pump and flow of sewage sludge is noted by a third man. The spraying is greater or less in volume upon particular spots or complete field areas, according to character of soil, contemplated crops or other local conditions. The slight odors from the nozzle are barely noticeable when the stream is flowing and are quickly dissipated by exposure to air and sun.

The practical results of this method of fertilization are readily apparent upon comparing the fertilized areas with those not treated. The crops of hay of this year's growth from fertilized fields were the largest ever known in this county.

The line of separation in the same field of unfertilzed area, was distinctly marked, while the yield was barely up to the normal standard of similar unfertilized fields.

So in a similar way the indicated crop of oats from fields with sludge fertilization will be far above the average. The standing fields of corn fertilized with liquid sludge are remarkable in rapid growth of stalk and ear as compared with others unfertilized. When the several crops are harvested and accurately weighed the results of this method of sewage farming will be more definitely known. The intention is for the coming year to divide fields into tracts of equal area, and cultivate these by using different fertilizers. Dried and liquid sewage, sludge, barn yard manure, garbage, and the various forms of commercial fertilizers. This will give definite results for future determination of actual manurial value of sludge in all the various forms.

The Canton sewage disposal works are recognized as being among the most advanced of their class of municipal works. No pains nor expense are spared to keep the operation of the works up to the highest standard. There has just been installed in the building over the screens and grit chambers an incinerator of the most approved type for destroying the sewage screenings, that are removed from the sewage before it passes to the sedimentations tanks. These screenings are a mass of paper pulp, rags, wood, and miscellaneous matters too large to pass the screens, and hold in suspension from 90 to 95 per cent. of moisture. They are worthless for any purpose and very troublesome and difficult to get rid of. There is approximately 125 pounds of screenings from each million gallons of sewage or about 500 to 600 pounds daily. The incinerator is placed beside the screening platform and receives the screenings as they come from the sewage, or if desired there is a small drying surface available for removal of the larger amount of liquids before burning. There is special apparatus for consuming smoke and gases of combustion and the heat is used for maintaining a steady draft in the steel stack of the covering house. This provides for the change of air in the building every few hours and eliminates any odors that might attend the passage of the sewage through the screens and grit chambers.

The operation of the sewage treatment plant has been under the direct charge of Mr. W. E. Sarver, City Engineer, since its construction, with Mr. Frank J. Eversole as Resident Superintendent, and Mr. A. E. Hess as chemist. Mr. H. A. Smith is Director of Public Service.

WHAT IS THE FUTURE OF ENGINEERING?

By Charles Kirby Fox, Consulting Engineer, 435 I. W. Hellman Bldg., Los Angeles, Calif.

Engineering, one of the oldest professions and certainly the most useful, had sunk to such a position that within

the memory of many men now living, to speak of an engineer conveyed the idea of a surveyor, draftsman or possibly a mechanic. Engineers as a class, in spite of the great magnitude of the work which they had planned and successfully carried to completion and its great importance to the world, were ranked behind the other so-called learned professions.

Wait, on page 7 (preface) of his "Law of Operations Preliminary to Construction in Engineering and Architecture" says: "It is not the mere competency to design, draft, lay out, and superintend work that gives reputation to an engineer. This is work done by assistants who are comparatively unknown to the profession. The men who control and direct the work are men of broad ideas and business capacity, whom companies and proprietors expect will look after their business conservatively and hold their investments secure and profitable. This, it is contended, depends largely upon their business and legal training. Without this training graduate engineers find their many technical qualifications without weight in the estimation of their employers, and they feel it keenly when men with a general education are taken, from the ranks of clerk and office help, and are given direction of work as superintendents and managers wholly on account of their knowledge of the business policy which directs the financial operations and because they know from association and study how to decide ordinary questions of business and law."

The realization of the truth of this statement, or some similar earlier one, evidently set some engineers thinking, for it was about this time that engineers really commenced to branch out into such allied commercial lines as contracting, managing and financing, where their technical training was of additional service. Now almost every contracting organization is headed by engineers and many large organizations such as railroads, utilities and cities are managed by engineers and quite a number have gone into financing.

Finally the World's War, virtually an engineer's war, came on and this brought opportunities wherein the engineer measured up so well to the allotted tasks, that engineering took unto itself an entirely new meaning in the public estimation and came very nearly placing an engineer in the White House. This combined with the unusual and rapidly changing state of affairs, brings up the question "What is the Future of Engineering?"

Will engineers continue in their strictly professional work with a strong representation in the related commercial, managing and financing branches, or will they rise to the occasion and take their places as leaders in the various phases of work in which they should rightly lead, such as settling troubles between capital and labor, seeing that fair utility laws are made and enforced, and enforcing a proper influence on the various related legislation which concerns them? In my opinion, there is no class or profession which combines the required training, knowledge, and experience to pass impartially on these great problems as well as do engineers. Their prosperity and welfare depends directly upon the prosperity and well being of capital and labor and upon suitable, fair legislation. Will they continue expanding and developing until engineering will be considered the proper basic training, not only for its numerous branches, but also the various executive and quasi-judicial positions connected therewith?

COMMENTS ON THE "KIRDORTHOFF," OR MODIFIED IMHOFF, TANKS

By W. G. Kirchoffer, Sanitary and Hydraulic Engineer, 22 N. Carroll St., Madison, Wis.

Since my article entitled: "Operating Experiences with Imhoff Sewage Tanks," appeared in the March, 1920, issue of MUNICIPAL AND COUNTY ENGINEERING, I have received a number of letters from prominent engineers and editors expressing favorable comment on my modification of the Imhoff tank. For the benefit of those who might be interested in these opinions, I give quotations from them herewith. For convenience of reference, and to indicate that this tank is a combination of the good features of the septic, Dortmund and Imhoff tanks, I have decided to call it the "Kirdorthoff" tank. The word is a coalition of the names "Kirchoffer, Dortmund and Imhoff." The quotations follow:

Chicago, Ill. April 10, 1920.

> Your method strikes one at once as so logical and based so completely on good hard sense that the good results you have secured in its application are only what one might expect.
>
> (Signed) EDITOR OF MUNICIPAL AND COUNTY ENGINEERING.

I have read with keen interest the March number of MUNICIPAL AND COUNTY ENGINEERING, containing an abstract of your experience with Imhoff tanks. This is the first time I have seen the paper, and I consider it a very valuable contribution to our knowledge of sewage disposal methods. I am all the more impressed with the value of your contribution, because very early in the exploitation of the Imhoff tank I came to the conclusion that it did not have enough storage space nor was it properly designed for the retention of very fresh sewage, which would inevitably rise, so far as my experience has gone, instead of dropping. I have followed the installation of Imhoff tanks somewhat practicularly, and almost every place where I have heard about them I have found it to be the fact that they did not work well with fresh sewage.

I would point out that reversing the Imhoff tank practically makes a tank such as we have designed at the Great Lakes Training Station and at Madison, Wis., that is to say, the channels separating the tanks, would in my opinion make it more certain that a more decanted liquid would be collected than would be the case with the reversed Imhoff tank.

I have laid your paper away for future reference among a very select list of what I consider to be valuable contributions to the art.

Chicago, Ill., April 6, 1920.

(Signed) John W. Alvord.

We were very much interested in the recent article in MUNICIPAL AND COUNTY ENGINEERING regarding your experiments with Imhoff tank construction. There is an immense amount of gas in American sewage as compared with the German sewage and we have been accustomed to the wasting of valuable greases, and our sewage is of a very dif-

ferent character from that on which Dr. Imhoff experimented.

It is undoubtedly a fact that Imhoff tanks in many instances have been built and used where a great deal of soap and other greases go into the sewage, where there is an immense kitchen waste, quite different from the ordinary municipal sewage. Plants constructed for the Government in connection with cantonments experienced this difficulty. There is a different condition also when the plants are built at a long distance in some remote section, the sewage having become much thinned out by considerable infiltration. All these conditions enter into the question of construction and your experiments undoubtedly are very useful in connection with certain installations.

Possibly Dr. Imhoff would have suggested different measures if he had the time and opportunity to have studied the conditions in this country. Possibly your plan might have been better for Imhoff tanks.

Should we continue to be identified with the Imhoff tanks, we may ask you for the privilege of publishing in the next booklet we issue the article which you have written regarding your experiments or possibly something later along these lines.

We have no way of telling at the present time whether we will be associated in any way with the future handling of the Imhoff patents. We are very much interested, however, in any kind of an experiment along these lines and your design appealed to us as a possible way to overcome foaming and we certainly hope that you have suggested a method which will improve tank construction, whether it is an Imhoff tank or not."

Chicago, Ill., April 6, 1920.

(Signed) Pacific Flush Tank Co.

Your kind letter of February the 27th was received here. You enclosed a copy of your paper on "Imhoff tank operation."

European sewage, from analyses, and from my own inspections, certainly contains less fatty matter than our own, particularly the sewage of our smaller towns. Therefore, it is quite natural that the behavior of sewage here may be, and often is, different from its behavior in Europe after it has reached disposal plants and is there treated.

The experience recorded in your paper is quite interesting. I am sending the copy you sent me to Dr. Imhoff for his information. He may send me a reply, with some comments, of which I will then send you a copy. I hope myself to go to Europe this summer and may see him and get some further data regarding the experiences during the last eight years, since I was there.

Let me give you some of my own comments:

Your word "sludge" does not cover Dr. Imhoff's meaning of the word. You speak of "sludge and scum on the surface of the upper tank" as being "3 ft. deep or more." Imhoff's sludge never rises to the top. It always either sinks to the bottom or goes off as suspended matter with the effluent. It never accumulates at the surface. The settled sludge, i. e., the heavier settling particles, if three to six months old, always flows out of the discharge pipe with the consistency of thick cream, when it is ripe, and it has no putrefactive odor, but only a slight odor, which resembles that of tar. If the sludge is putrescent, it is not yet ripe, and still contains sulphur bacteria, which have not yet been exterminated by the multitudes of bacteria, generating chiefly methane and carbon dioxide gas, both of which ordinarily escape from the tank and neither of which has an offensive odor. The sludge should never be withdrawn until it is ripe.

The Imhoff sludge, when withdrawn, runs into small channels made in a bed of sand, to a depth of a few inches only, then it dries out within a few days of clear weather and becomes friable, and is no longer sticky and then it has no odor.

If these conditions do not exist, then either the sewage is different from the European sewage, or our treatment of it has not been proper. The latter is often the case. Many consider the process wholly automatic under all conditions. This is not correct, and the treatment always needs intelligent care and supervision. The sewage must remain in the upper tank into which its first flows, long enough to flow slowly enough to allow of sufficient sedimentation, so that the effluent is fairly clear. This is not always accomplished, particularly when the center flow is much more rapid than the side flow, which is in fact a common cause of imperfect results and should not be. It can be prevented by proper baffling.

Our sewage, although much more dilute than the European sewage, has much more greasy matter. The greater dilution necessitates a somewhat slower flow for sufficient sedimentation. The greater amount of grease with us rises to the surface and forms the scum which is sometimes several inches thick. This scum is the most troublesome feature of the treatment. Our American sewage is sometimes greasy enough to make it worthwhile to let it pass through a grease trap of sufficient size and proper construction, so as to catch the grease and allow it to be removed separately. Hotels and eating houses, if not all houses, ought to have a grease trap on their private sewers, before these discharge into the public sewers.

Grease decomposes more slowly than the easily putrescible matter but when it does decompose its heavier parts also sink to the bottom. I think it is best in some cases to skim off this scum, drain it in bags, or press it into cakes, and then burn it together with some light combustible matter, or bury it in shallow trenches, where it decomposes in one or two years, depending on the season of year or climate.

If the effluent covers the filter bed with a "thick leathery deposit" and clogs the soil, then the sewage has evidently not settled long enough, or the channel surfaces on the filter bed have not been raked often enough to break up the film that may form. In England the filter beds are sometimes raked over twice a week.

A very small addition of milk of lime to the sewage of small towns, particularly if this is acid, will

help coagulation, hasten the sedimentation, and produce better sludge.

If the effluent smells under the right treatment, then the sewage when reaching the tank is older than it should be or need be, if the sewers are properly graded, of smooth interior surface and frequently flushed. The sewage will then flow with sufficient rapidity so that it will not become foul before reaching the outflow. The remedy is, better attention given the sewers and greater cleanliness in them.

Miami, Florida, March 15, 1920.

(Signed) Rudolph Hering.

I am taking the liberty of sending you under separate cover some prints of the proposed Imhoff tank, and if you care to, I would be glad to have you criticize the design.

I must say that your article is somewhat of a "bolt from the blue," as I know of many Imhoff tanks that have been and still are operating without any of the troubles which you have found. Our problem is one of domestic sewage only, without trade wastes of any kind.

Bids for the Ames work will be opened June 7th, with little chance of getting a satisfactory contract, due to material and labor conditions. There is yet time to make such changes as would permit of either method of introducing the sewage into the tank.

Thanking you for any suggestions that you may see fit to make.

Ames, Iowa, May 26, 1920.

(Signed) P. F. Hopkins,
Mgr. Dept. of Engineering.

Mr. Alvord's reference to the Madison plant is evidently intended to refer to the manner in which he designed it and not to the manner in which it was actually built. In its present state it is practically a septic tank with separate sludge chambers.

Dr. Imhoff evidently intends to have the sludge in his tank of a character to suit his own liking. I wish we could do that in this country. Possibly if he had some of the American sludge to contend with he would change his definition. As the Irishman said, "The ding" stuff won't work that way.

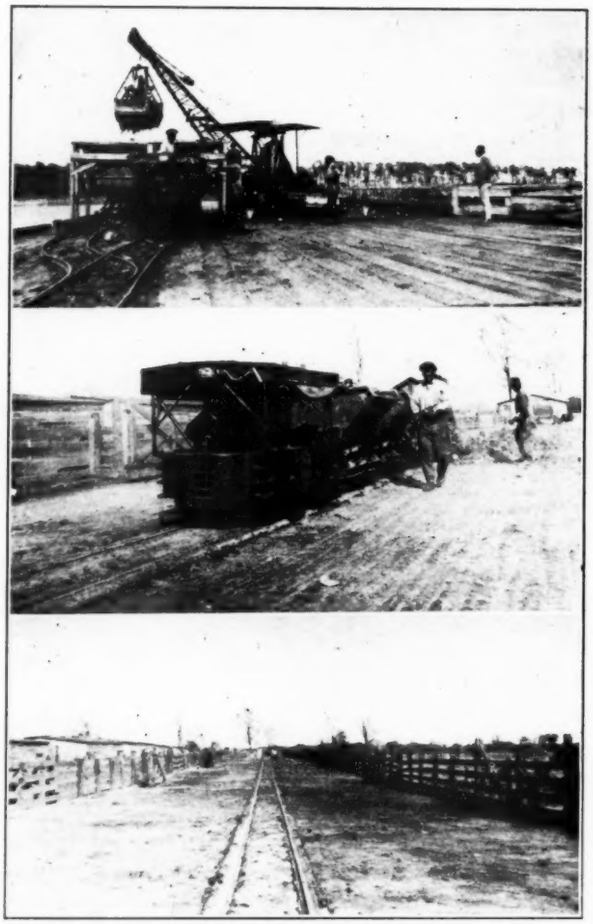
It is my opinion that American sewages are gradually but positively changing in character. The creamery, cheese factory and condensary wastes have a marked effect on sewage where the proportion of such waste is large as compared to the volume of domestic sewage. The automobile garage is getting to be quite a factor in producing a waste that is most difficult to handle. Where all or even a part of the storm water enters the sanitary sewers the oil from oiled streets and the oil and grease dropped from automobiles are also factors.

SOME FEATURES OF GARBAGE DISPOSAL BY HOG FEEDING AT BALTIMORE, MD.

The disposal of garbage by feeding to hogs has been in effect in Baltimore, Md., since May, 1919.

The farm, situated on Bodkin Creek (just north of the Magothy River), is owned by the city and leased to the American Feeding Company. The city pays the cost of collecting garbage in the city and pays for towing it to the farm. On the other hand, the American Feeding Company pays the city for each ton of garbage 3½ times the average top price per pound of live hogs for the month on the Chicago market, so that the price received by the city fluctuates with the value of the hogs.

The financial result of these operations for four months late in 1919 was that the city received about $7,000. The cost of towing during this period was about $2,500, yielding a profit to the city shown not only by the actual receipt of money but by avoiding altogether the payment of money to a contractor, as in previous years, for the disposal of garbage, usually some $75,000 a year. This justifies the statement that the system is satisfactory to the city.



VIEWS OF EQUIPMENT FOR HANDLING GARBAGE AT BALTIMORE FEEDING FARM.

Top: Pier Showing Garbage Scow, Austin Crane, Hopper, Track, Cars and Locomotive with Bucket of Garbage About to be Dropped Into Car. Center: Plymouth Locomotive Hauling Loaded Cars and Dumping Garbage on Platform. Bottom: Feeding Platform of Concrete with 24-in. Gauge Track; Hog Lot Fences on Either Side.

Equipment Used in Handling Garbage

The garbage is collected by the city, loaded in scows and delivered to the American Feeding Company alongside the company's dock. The feeding floor is of concrete 33 ft. wide and 700 ft. long and located about 1,400 ft. from the pier. The garbage is unloaded from the scow with an Austin Model 5 DL machine, located on the pier, and equipped with a 1 yd. Haiss clamshell bucket. A

24-in. gauge industrial track extends from the pier to the feeding platform and through the center of it from end to end. The garbage is dumped through a hopper into 1½-yd. Koppel steel rocker dump cars and hauled to the feeding floor, with a 3-ton Plymouth gasoline locomotive, where it is dumped. The hogs are then turned in on it.

During the summer season from 5,000 to 6,000 hogs are fed at this farm and during last winter about one-third of that number were fed. The accompanying views of the feeding platform and equipment were furnished by Mr. Walter W. Cooper, manager of the American Feeding Company.

DESIGN AND CONSTRUCTION OF THE MEMORIAL BRIDGE AT DES MOINES, IOWA

By K. C. Kastberg, Secretary, Board of Engineering Examiners, Des Moines, Iowa

On January 9, 1920, the following resolution was adopted by the city council: "That the University Avenue Bridge be designated and named 'Memorial Bridge' in memory of those from Des Moines who fought in the World War." Although operations began before the period of strife, the major part of the construction proceeded during the war.

The structure was first known as the North Street Bridge, named after the old street, and later University Avenue Bridge, because this avenue is now absorbing old North Street in connection with the development of the city boulevard system.

Location

The bridge site is a mile up the river from the west side business section. To the south is a flat expanse of sand, while to the north lies the picturesque woodland, the aesthetic qualities of which remain ungathered; the bridge stands out in bold relief flanked by unsymmetrical surroundings. Viewing the profile from the south, the east bank drops abruptly a distance of nearly 75 ft. to the water, and about 600 ft. across; the west shore gradually slopes back for three-quarters of a mile in a concave curve, finally reaching about the same elevation as the east side. The river separates the residence sections, the better types of houses on the high lands, while the more lowly ones dot the bottoms. Along the ledge of the cliff the Chicago and Northwestern railroad has its right-of-way and about 1,000 ft. from the west shore, the interurban tracks lead from the city.

Need of the Improvement

There had been no direct path across the Des Moines river at this point, only a round-about course, either over the Sixth Avenue bridge, around the bend and a mile to the north, or over one of the four down-town bridges, almost a mile to the south. Two of these were also new bridges, just being completed. That a bridge would be necessary soon was apparent, although there was some opposition both in regard to the advisability of building a bridge at this time and also in regard to the exact location, the latter having been considered before the University Avenue Boulevard plan was fully completed or comprehended.

Type Chosen

The physical requirements included the spanning of approximately 600 ft. of stream at normal water level and about 1,500 ft. during high water, also the northwestern track and the connection with existing grades at each side of the river. When the gates of the new dam, three-quarters of a mile down stream were closed, the normal water level was raised 6 ft. to elevation 13.0.

Too steep a grade was to be avoided as this might not invite traffic. With the decision of a 3 1/3 per cent. grade as the maximum, the problem of handling existing conditions remained.

On the east side University Avenue is intersected about 500 ft. from the edge of the bluff by East Seventh Street, the first street extending north and south. This, as well as Pennsylvania Avenue, further east, would be the logical street for approach. With the exception of that part of University Avenue between the bluff and East Seventh Street, all the streets were narrow, and though improved with paving, curbs and walks, lay practically level, and were lined on both sides with modern residences. On the west side the shore was barren, except for two or three cottages between the river and the interurban tracks, but further west the streets were well built up. Here, again, University Avenue was very narrow, and like the side streets, was not paved.

Because of the interurban tracks, the west approach was fixed to begin either at this point or farther west in order to provide clearance. The elevation, 400 ft. west, is 10 ft. higher than the track, elevation 21.0, and by careful manipulation of the several streets, the main grade up to the crossing might have been kept well under 4 per cent. Then beginning a 2½ per cent. grade 26 ft. above the track and extending it east, we would reach the top of the bluff. In this manner existing grades would have remained practically unmolested at both ends. But such a plan would have meant a very large and much more expensive structure. Controlled mainly by financial considerations, the verdict placed the beginning of the west approach at the interurban tracks with a uniform grade of 3 1/3 per cent. to East Seventh Street, and a 2 per cent. grade to Pennsylvania Avenue. A 7-ft. cut at Seventh Street helped provide earth for the west approach fill, where an earth fill was chosen instead of a concrete viaduct because the cost was $50 less per lineal foot.

Size

The bridge proper is a reinforced concrete structure of the open spandrel type with six arches. Beginning at the west with arch No. 6, a 103-ft. span, we have 115, 127, 139, 151-ft. spans, and arch No. 1, an unsymmetrical span of 128 feet over the North Western tracks. The rise is increased in proportion to the span length with the apparent spring line constant at elevation 21.0, the top of the pier opening. Each arch is made up of three ribs, the middle one 7 ft. wide and the outside ones 4½ ft. wide.

In addition to the regular live load of 100 lbs. per sq. ft., plus 25 per cent. for impact, the bridge was designed to carry two 50-ton interurban cars, coupled on tracks 10 ft. on centers.

The floor is made up of slab, beams and girders, the latter occurring at the panel points, 12 ft. apart. At the expansion joints the girders are 5 ft. deep, otherwise 4 ft. Two expansion joints are either 7 or 8 ft. apart at each pier, depending on the pier width that was increased

for the larger arches. Joints also fall near the center of the arches from 24 to 36 ft. apart. The roadway is 42 ft. between curbs, paved with vitrified brick and pitch filler, laid on a 1½-in. sand cushion. At the center, the slab is 9 ins. thick and decreases at the curb to 7 ins. where it drops 3 ins. The top of the 8-in. curb is grade, making the 6-in. crown of the finished pavement 2 ins. below grade. Cantilevers support the 6-in. walk slab, 6 ft. wide from curb to inside base of handrail. The walk slopes 3/16-in. to the foot.

The over-all width of the floor is 57 ft. and the length is 798.5 ft. On each side a cantilever-supported stairway, 7 ft. wide, drops toward the west abutment to a landing, then turns inward to another landing, finally reaching the ground level on each side of the middle rib. Eventually this will lead the pedestrian to a boulevard passing under arch No. 6.

The waterway required was not considered because of the height of this bridge.

Materials

The materials included principally: 57,000 ft. of squared lumber, 355 tons of reinforcing steel, 20,000 ft. of false work piling, 14,580 bbls. of cement, 7,333 tons of sand, 11,533 tons of crushed rock and 8,600 ft. of foundation piling.

Labor

All labor consisted of local help which was divided into common labor, form builders, mechanics, finishers, riggers and engine operators, teamsters, day and night watchmen and foremen. The maximum number employed per day was about 125. Remarkable loyalty was displayed in spite of keen competition between gangs doing similar work. For a short time during the war labor tightened up a little and efficiency dropped.

Late in 1917 when the work first began, common labor was paid about $3 for nine hours, while toward the close, the rate varied from $4.50 to $5.40. The carpenters' rate advanced from $4.50 to $6.30 and $7.20, teams from $6 to $8 and foremen from $5 to $7.

Cost

The total cost of the bridge and approaches was $390,867.15. Of this amount, $355,800 included the bridge and west approach. Deducting $58,712 for the fill with brick paving on a 5-in. concrete base and two 5-ft. walks, left $297,088 for the bridge structure. The cost of grading the east approach, providing 5-ft. walks, curbing and asphalt paving was $35,067. Although no definite figure is yet at hand, it might be well to speak of the whole east side improvement here. East University is being widened at present as far as Ninth Street, but the part included in the bridge contract extends only to the west line of Pennsylvania Avenue. The bridge contractor widened University Avenue to 42 ft. between curbs, and the south property line was shifted to make the street 91 ft. wide. East Seventh Street is also being changed from 22 to 30 ft. between curbs, and the west line will be moved to make this 79 ft. wide.

The above changes necessitated the razing and removal of a great many houses, both for the benefit of the better approaches provided and the acquisition of a park site between Seventh Street and the bridge. This park will be named John Burke Park in honor of an East Des Moines boy, incidentally a former member of the city engineering department, who died of wounds in France.

There were a few small extras for such conditions as the investigation and protection of a large sewer that lay in the vicinity of the east abutment, also the provision for a pair of small wing walls for this abutment. Although work on the east approach was classed as an extra in the monthly estimates, it was really a part of the bridge contract.

Financing

The improvement was financed by a bond issue to be liquidated by the levy of a special tax. The contractor received compensation on the basis of monthly estimates, less 15 per cent., for work completed and for materials received.

Methods of Construction

The west shore was chosen for the plant and storage site, as well as the point to begin operations. A spur from the interurban tracks was led from the south for some distance straight along the river bank and ended just north of the bridge. A steel guyed derrick west of the track unloaded crushed rock, sand and piling, and served the hoppers over the loading pit. Lumber was stored near the wood shop, south of the rock pile. Many of the curves were laid out on the wood shop platform that served as a large drawing board, and after the false work trusses had been assembled in sections, they were thrown into the river by the derrick and towed by motor boats within reach of the derricks that set them in place. The cement storage house and plant occupied the space between the storage piles and the bridge. The mixer was driven by a horizontal steam engine and was charged from a hopper above into which the incline compartment car from the loading pit dropped its load. Office, blacksmith shop and steel storage were north of the bridge.

Dry excavation for the west abutment and pier No. 5 was followed by the driving of foundation piling about 12 ft. long after being sawed off, 274 ft. for the abutment and 150 ft. for the pier. The penetration per average of the last five blows was inserted in accordance with the Engineering News formula, supporting power in pounds is equal to the weight of the drop hammer in pounds multiplied by the length of fall in feet and divided by the quantity one plus the penetration in inches. This always indicated more than the required 20 tons as called for in the specifications. Weight of hammer used was 2,200 lbs. and the drop was 26 ft. While equipment was being assembled, these pile and foundations were handled in a temperature sometimes 20 deg. below zero, but the concrete was very well protected with steam pipes, salamanders and canvas.

A stiff-leg derrick excavated for and built the first river pier, No. 4, which extended just far enough to be within reach when the mast was placed on piling near the shore. The cofferdam for this pier was typical of all four used, although No. 3 was the largest and No. 4 was built during the most severe winter weather. The whaling timbers were framed on the ice for a rectangular cofferdam, 20 x 65 ft. Then by sawing the ice around and from the weight of several frames, the sinking and placing was accomplished. Four by eight grooved wooden sheet piling 20 ft. long was driven and backfilled. Except for a few slight blow-outs, this and all other cofferdams went down in good order. Two 6-in. centrifugal electric-driven pumps were used on all cofferdams. In-

termittent pumping, and removal of the 5 odd feet of sandy, muddy material of the river bed, exposed the rock. This presented a fairly smooth surface so that 1¼-in. dowels were placed, projecting into the rock 2½ ft. A 5½-ft. test hole gave further conclusive evidence of sufficient thickness. The rock at the other piers was very rough.

The west abutment with its retaining walls and piers No. 4 and 5 were poured almost entirely by means of wooden spouts hung from cables between the large tower, 104 ft. high, and various smaller towers. On April 8, 1918, when the abutment was half poured, fire wiped out the complete mixing plant and storage house full of cement, but left the big tower intact and did not even scorch a form.

The traveling derrick passed over the piers at about elevation 22, and with the aid of the barge derrick placed all of the false work and cofferdams, except pier No. 1 and the east abutment.

The umbrella section of each pier began at elevation 17.0 and was poured before the arch between. Then the pier was built up to grade before the arch forms had been completed.

The total form work was 1,154,000 board feet and the concrete amounted to 10,200 yds., divided mainly into 1:2:4 and 1:3:6 proportions. The former was used all over except for railings and footings. Each footing contains about 260 yds. at 1:3:6 mix.

The outside ribs contain ten 1⅛-in. square bars, top and bottom, and the middle has 14. One ½-in. square hoop is 24 ins. on centers. The roadway slab is reinforced with steel at top and bottom.

The beam side and bottom forms were made of 2-in. lumber as well as the columns, struts, and parts of the handrail and stairways. No. 9 and 10 wire was used in wiring the forms, except the columns which were yoked with four by fours, bolted. The sides of all ribs were bolted with rods in four sections so that the short ends could be unscrewed when the forms were stripped. For ribs, piers, pilasters, retaining walls and foundations, 1-in. sheeting was studded with two by fours, usually on 2-ft. centers, and whaling, two 2 by 6's on 3-ft. centers.

Pier No. 3 was made an abutment pier on account of the danger of a shut-down that might result from war restrictions. Fortunately all material to complete the work had been delivered to the site, except cement, the storage capacity of which was limited to three carloads, but as soon as arch No. 6 was completed a shed was made of it by hanging heavy canvas from the roadway on each side and laying a heavy timber platform well out of reach of high water, which would contain nearly all the cement required.

High water reached elevation 21.0 on June 6, 1918, during the flood, just as cofferdam No. 2 had been cleaned and pumped out. Motor boats encountered and tied up all floating trees and debris upstream and no damage was done. The spur track was completely inundated as well as a few of the low spots back on the interurban track.

The arches were poured with special care, giving due consideration to the balancing of loads and the effect on adjacent arches. The floor was also placed in a systematic manner. A trestle was built along the centerline of the bridge about 6 ft. above grade and this was extended as fast as the false work was set up. Three rebuilt Ford cars with flanged wheels served as locomotives, hauling hopper cars for concrete, and flat cars for lumber and supplies. Part of the time the trestle train spouted to another train that followed the traveling derrick in building the piers. Finally, after the arches were poured, by providing switches and a steam shovel on the east side, three trains of four cars each transported 25,000 yds. of earth to the fill. Gravity brought the loaded cars over and the Fords hauled them back.

Meanwhile about 10,000 yds. of earth had been hauled into the fill by team until the time of the flood, which, aided by rains, made it too difficult to go on. Then a 10-in. sand pump on a barge was rented to pump in sand at the rate of about 500 yds. a day, until an additional 10,000 yds. filled the low places.

The east abutment plan called for 180 foundation piles, but when the excavation reached the point where the bottom of the foundation was to be, coal and old mine struts were uncovered. The foundation was extended 2 ft. lower for the material was too hard to drive piling into. A 2-course brick sewer, 48 ins. in diameter, was found to lie in a diagonal direction 28 ft. below the abutment foundation. Upon digging a 6-ft. hole to this sewer through very hard material, slate shale, fire clay and coal, it was discovered that it had been tunneled and not backfilled. The sewer was tapped on top with an 18-in. sewer pipe that extends up through the back of the abutment without affecting the strength of the middle rib. The hole was then filled with lean concrete and a manhole set in the bridge floor. A heavy rainfall caused an earth slide that delayed progress a little, just before pouring the foundation.

The bridge walks and rails were poured during the summer of 1919, and although wetted down, the walks showed hair cracks. The men stripping forms under the floor remarked about the stifling heat at this time.

All the large and intermediate handrail posts were poured in place as well as the rails, but the small post caps and the spindles were precast.

During the cold winter months canvas was hung from the roadway, and with the aid of suspended salamanders delays were prevented, although this method was somewhat more expensive.

Progress of the Work.

Actual construction began in July, 1917, when the contract was let to the contractor by the city council. The general progress was satisfactory considering the abnormal conditions affecting the work. When the east side grading was under way, injunctions caused delays. The bridge proper stands completed.

East University Avenue is finished, but south East Seventh Street stands in a partly graded condition since the condemned houses have not been razed and removed. North East Seventh is practically intact, presenting a sheer cut-off of 7 ft. The fill is gradually being completed and will be paved as soon as settlement will not be enough to injure the paving.

A design has been completed to bridge the interurban tracks to make a safe crossing connecting the fill with West University Avenue although at the present time the light traffic on the railway does not warrant the construction of a viaduct. West University Avenue has been widened and graded and the contract let for the paving.

Since $35,000 remained to be paid the contractor, who was unable to finish the work on account of the injunctions, a new agreement was made with the city on Feb. 13, 1920. The contractor was released from the original large bond substituting a smaller one. He was paid $16,000 which left $19,000, the cost of completing East Seventh Street on the original unit price basis, to be done as soon as restrictions were removed, and of providing earth to finish the fill. The contractor waived all claims for damages.

Personnel.

The contractor was William Horrabin of Iowa City, Iowa. The design was prepared by Dana E. Thomas who was retained as superintendent until February, 1919, when he resigned, and Edward M. Mahl was made superintendent. The work was handled by the Department of Streets and Public Improvements, John W. Budd, superintendent. Engineering and supervision for the city by: Karl C. Kastberg, City Engineer; John M. Tippee, Construction Engineer; Herbert W. Hahn, Resident Engineer of Construction.

The foregoing paper by Mr. Kastberg was presented at the 1920 annual convention of the Iowa Engineering Society.

HANDLING MOTOR TRUCK TRAFFIC ON TRUNK HIGHWAYS OF MARQUETTE COUNTY, MICH.

By K. I. Sawyer, Superintendent Marquette Board of County Road Commissioners, Ishpeming, Mich.

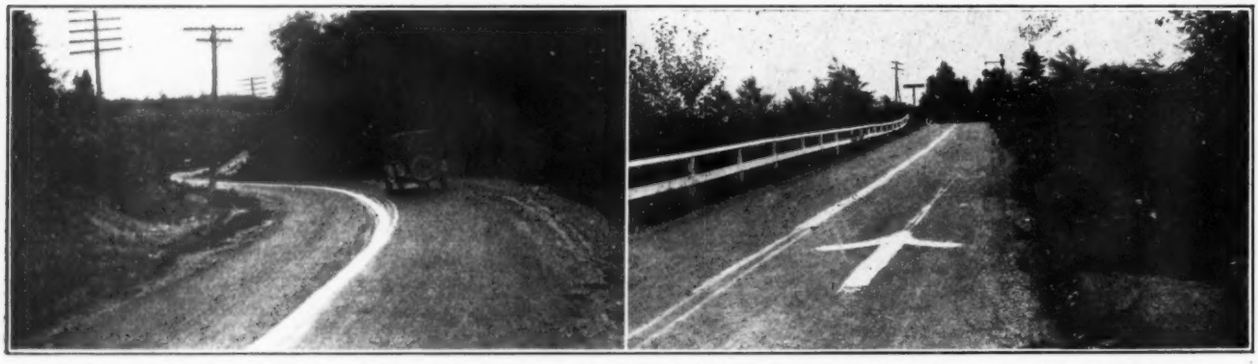
The handling of motor traffic upon our main trunk highways through the country is rapidly becoming as serious a problem as traffic control has ever been in our cities, and at some points it has been necessary to borrow the methods of city traffic control for application to the handling of traffic upon more congested trunk lines.

One interesting illustration of this is in Marquette county, Michigan, where the traffic on the trunk line between Marquette and Ishpeming has become heavy enough to make travel dangerous unless some means of control is adopted. The main road between Ishpeming and Marquette is a beautiful example of waterbound macadam built of hard green trap rock. About four years ago the traffic on this road became heavy enough to break the bond in the macadam and the road started to ravel out. The writer rebonded the portions that were most badly ravelled, adding limestone chips as a binder and seal coating with Tarvia B. The whole road has received two light applications in these four years and is now presenting a smooth and perfect surface to the traffic.

This road was originally laid out as an ore teaming track from the iron mines at Ishpeming to the boats at Marquette, and, of course, was designed only for team travel. Inasmuch as this road drops 900 ft. in seven miles through a hilly country, there are numerous curves and grades. The maximum grade is 6 per cent, but some of the curves are of a higher degree than is now considered good design for present motor traffic. The traffic, which has now passed the 1,200 mark per ten hour day, was beginning to get dangerous to itself, inasmuch as the visibility was low on these curves, due to the shoulders of the hills and the heavily timbered country which borders the roads. To relieve this situation the writer painted white 8 in. center lines upon the black surface of the road upon the more dangerous curves, with an arrow pointing down the right hand side of the road at either end, this to counterbalance the tendency of auto drivers to hug the inside of a curve regardless of the danger of hitting the traffic approaching which might be invisible to them at the time. The effect was immediately apparent, as the auto drivers accustomed to obeying control signs in the city immediately responded to the appeal of the white line and kept to the right hand side of the road, and the immediate reduction in the number of accidents indicated that the scheme was worth while.

The writer has had this center line system of control in use for three years, and is well satisfied that it is the best thing he can do to protect traffic using this road. The road is the main highway between two rapidly growing communities, and the wonderful country through which it leads is drawing tourists in greater numbers every year, so that his problem never becomes less but rather tends to become greater.

The white paint used for this work is the tpye of whitewash prepared according to the formula used in the U. S. lighthouse service. The patrolman touches up the center line every Saturday morning, but unless the rains are especially severe there is little difficulty in the lines lasting a month without attention.



TYPICAL TRAFFIC CONTROL MARKINGS ON SURFACE OF MARQUETTE TO ISHPEMING (MICH.) HIGHWAY.

The left view illustrates the sharp curves and steep grades on this macadam road, built in 1908-1909, and resurfaced in 1916 with Tarvia B. The pictures were taken in August, 1920. The 1920 traffic counts at this point show 900 to 1,600 vehicles in a 14-hour day. The right view shows a 6% grade to a railway crossing on each side and a rock bluff adds to the low visibility. The paving markings have reduced accidents.

The scheme has been so successful that the writer does not hesitate to recommend it to other county road engineers who have similar problems to meet. Not every road surface lends itself so readily to center line painting, for the smooth black surface in this case was ideal to make the white center line stand out in sharp relief. Some color scheme can usually be worked out so that the traffic can be reminded that the right hand side of the road is the only side that properly belongs to them. The motor public as a whole is only too willing to take a hint which is for its own safety, and the scheme is sufficient reminder to keep traffic within bounds and allow a much heavier traffic to use the roadway without danger, which is not usually the case on our county highways.

ENGINEERING PHASES OF THE WATER SITUATION IN CALIFORNIA

By Stephen E. Kieffer, Consulting Engineer, Mechanics Institute Bldg., San Francisco, Cal.

Easily first among the factors affecting California's prosperity is its water supply. Unusual conditions have created a critical situation calling with unexpected suddenness for the solution of water supply problems of the first magnitude, the solution of which must rest with the engineering profession. Hence it is thought that a brief statement of the principal existing conditions, and of some of the problems to be met, will be of general engineering interest.

California, within its 800 miles of length and 200 miles of width, runs the gamut of things climatical from rainless Death Valley on the south to the excessive rainfall of the Coast forests on the north, and the lofty Sierras on the east to the Pacific Ocean on the west. But for the most part the State is semi-arid, with an average rainfall of from 10 to 30 ins. per season over the agricultural valleys. This rainfall is distributed seasonally from about September to March, leaving a so-called "dry" season of approximately five months each year. During this period irrigation is practiced.

The water development of the early days was principally carried out by the miner of the Sierras for the extraction of gold. But gradually, with the passing of the cattle and wheat kings of the valleys and the increase of population, agricultural development made increasing demands and the water of the mountains was carried to the valleys. The first easily acquired water rights were easily and cheaply developed, but through a long period of years up to the present time water has become increasingly difficult and expensive to obtain.

Unprecedented Demand for Irrigation

The 1920 census will undoubtedly show that California has made tremenduous strides, and will take position well to the front among the states, in population. Every indication points to a continuous and rapid growth. Normally such a condition of affairs might be expected to increase the demand for irrigation water, since the natural climatic attractions of California, and the productiveness of the soil under irrigation, lead the settler to agricultural and horticultural pursuits. But to the war only, with its demand for increased output of the soil and high prices, can be attributed the abnormal demand for water of the past three years. To the normally accepted belief in the physical necessity for water to produce certain crops there seems to have been added a sudden and intensely developed realization of its value in increasing production along all lines. New crops also, such as cotton and rice, are assuming great proportions. In conjunction with this condition has occurred the most prolonged period of low rainfall ever recorded in the State. The natural result has been that the present demand for irrigation is unprecedented in California, and energetic efforts are being put forth to procure a water supply in every section and for every class of crop that irrigation will benefit. This activity is no doubt hastened by the awakened realization that at 100 per cent. development the water resources of the State will fall far short of its ultimate needs.

Great Demand for Water for Power Purposes

Nor is the demand for water less acute for power than for irrigation. California has led the world in the development of hydro-electric power and its long distance transmission. As the surface sources of irrigation water supply became more difficult and expensive to develop, the pumping of underground water was resorted to through the use of electric power. This consumption has grown to enormous proportions, thus establishing a never ending and ever widening cycle of interdependence. Hydro-electric power and irrigation development will be more intimately connected in the future than in the past. Water stored in the mountains and used for power will be used through surface canals for valley irrigation, and again used for pumping through the agency of the power first created. A review of the present water situation, and its engineering phases cannot, therefore, be confined solely to its application to irrigation. Nor is the power phase of the subject confined to agricultural development alone, but it affects every city and town where electric power is supplied. From this angle the dependence upon water is further emphasized and made of the first magnitude due to the present critical situation resulting from the unprecedented demand upon the State's fuel oil supply, the visible reserves of which it is claimed are being drawn upon.

Dry Years

With the increasing demand for water the influence of seasonal variations of supply, dependent upon rainfall, become more important. A marked departure in precipitation below the long time average marks the "dry" year, as differentiated from the average. No fixed rules can be laid down, but in general terms the records seem to indicate that in California single dry years occur on an average about every 5 years; a cycle of two successive dry years every 12 to 15 years, with a three year dry cycle unknown in the past as recorded. History is now being recorded, however, and the State is passing through the third successive dry season. Present indications are that the emergency will be met, both as to irrigation and power requirements. But the margin of safety has been used up. All minds refuse to contemplate the unheard of possibility of a fourth successive dry year, or a repetition of the present conditions in conjunction with the future certain growth of population and agricultural development. Guarding the future against such a contingency is the awakening motive among all classes and interests.

The solution of the problem must eventually be worked out by the engineering profession. This article is only intended to state briefly existing conditions, and point out some of the future projects involved.

California is roughly divided by its mountain ranges into a few principal geographical and drainage divisions, which have climatically marked and separated physical conditions, without relation to each other. East of the Sierra Madre mountains, in the southeast corner of the State, is the great Imperial Valley, fed by the waters of the Colorado River, and having no relation to or bearing upon the water supply of the rest of the State. South of the Tehachipi mountains, and between the Sierra Madres and the sea, is the region popularly known as Southern California, with Los Angeles as the central city. Intensive application of water to high class crops has long since resulted in the development and use of all of the water tributary to this region. This supply has been augmented by water from the eastern slope of the Sierra Nevadas and carried over 200 miles through the Tehachipi mountains by the great Los Angeles aqueduct. While primarily for municipal use this water is also used for irrigation. From the Tehachipi mountains on the south to the Siskiyous on the north, with the Sierra Nevadas on the east and the Coast Range on the west, there extends for 500 miles the Great Valley of California, containing 20,000,000 acres of cultivable and irrigable land. Probably half of this will never be irrigated for lack of a water supply. Here is to be staged the scene of the State's greatest development, with its foundation of prosperity resting upon the water available for irrigation and power uses. While one physically and geographically this Great Valley is separated into two general drainage areas known as the San Joaquin Valley on the south and the Sacramento Valley on the north, these names being taken from the principal rivers draining the valley north and south to a confluence and outlet at the Bay of San Francisco. Numerous important cities and towns, including the Capitol city of Sacramento, are scattered throughout the length and breadth of these valleys, while at their natural outlet at the Golden Gate are located the cities of San Francisco, Oakland, Berkeley and others of the municipal area with a combined population of about one and one-half millions.

A Great Irrigation Development

Irrigation of this great valley has been practiced in varying degrees for many years, dependent upon location and crops, with the greatest development where water was cheapest and most plentiful. Practically the entire water supply comes from the streams flowing from the continuous and unbroken range of the Sierra Nevada mountains on the east. Throughout the length of 500 miles fourteen major rivers, having their sources in the Sierra summits, and many secondary streams of large size, enter the valleys. The Coast Range contributes no water to the west side of the San Joaquin Valley, but a considerable volume to the Sacramento Valley. The Sacramento Valley on the north is naturally much better watered than the San Joaquin on the south, with just about double the average rainfall (approximately 20 ins. as against 10 ins. per annum). The inevitable result of this condition was the slower awakening to the value of irrigation in the Sacramento than in the San Joaquin Valley. All streams entering the San Joaquin Valley were long ago utilized to their maximum, and for years past practically no water has flowed to the Bay through the lower reaches of the San Joaquin River during the summer months. In the Counties of Kern and Tulare, forming the southern end of the San Joaquin Valley, the entire flow of the Kern, Tule, Kaweah and a portion of the Kings rivers (all of large size) is retained south of the Kings River barrier and accumulates in wet years in Tulare Lake. Only three times in sixty years has this lake overflowed to the north into the San Joaquin River and thence to the sea. The waters of Kings, San Joaquin, Merced, Tuolumne, Stanislaus and Cosumnes rivers are utilized through great canal systems to irrigate as far north as Stockton, the most northern city of the San Joaquin Valley. Greater demands for water in this valley can therefore only be met by greater development through reservoir storage or pumping, and the problems involved are fairly fixed in their character and scope.

Beginning at the city of Sacramento and going north for 200 miles through the Sacramento Valley a very different set of conditions is presented. Here a more abundant rainfall, combined with a resulting lessened interest in irrigation due to the greater volume of dry farming, created a comparative abundance of stream flow. The Sacramento River was a stream of large volume at the time of lowest seasonal flow throughout the 200 miles or more of its length. At Sacramento the normal flow of the river during late summer was generally from 5,000 to 6,000 second feet. Navigation by large river steamers is carried on throughout the year as far as Sacramento, and for a good portion of the year to the upper end of the valley at Red Bluff. For those who wished to irrigate there seemed an abundance of water to be had for the taking from the great and (supposedly) inexhaustible Sacramento River.

Such was the situation as it affected the Great Valley above the range of tidal influence of the sea. Beginning at Sacramento and Stockton and extending for 70 miles to the confluence of the Sacramento and San Joaquin rivers at the tidal waters of Suisun Bay the river channels flatten, and through the agency of many sloughs create what is known as the delta region, or "islands," of the Sacramento and San Joaquin. This delta region is of great extent, and the soil marvelously rich. All of the land is reclaimed from overflow during floods by levees. Due to the elevated channels resulting from the deposits of early mining debris the water surface even at low water is generally higher than the adjacent land. Drainage by pumping is resorted to, and either sub-irrigation or irrigation with surface water supplied by siphons over the levees is practiced. Here the problem was rather too much water than too little, and interest was centered in the danger from winter floods rather than from summer drouth.

Effects of the War

Such were the conditions at the time the United States entered the great war in 1917. Then began the great demand for products of the soil at war prices. About that time also a new industry was being established in the Sacramento Valley—that of rice culture. Under the war stimulus this grew by leaps and bounds, until in 1920 the crop covers 150,000 acres, and is valued at $60,000,000, thus ranking the Sacramento Valley as one of the great rice producing sections of the world. With the advent

of this rice culture, combined with the general irrigation awakening, every drop of water in the valley is in demand several times over. Applications made to the State Water Commission up to May 20, 1920, for water from the Sacramento River proper aggregated 10,502 second feet. The permits granted to the same date (the last on September 29, 1919) aggregated 3,901 second feet. During the low water season of 1919 the flow of the Sacramento River at Sacramento averaged about 2,500 second feet. It is therefore apparent that the pending applications now on file are two and one-half times the low flow passing Sacramento last season, and the granting of any of them is a matter of moment to the delta land owners below Sacramento. During the present summer the river flow at Sacramento has been kept about as in 1919 as the result of a mutual agreement between all the present water users in the Sacramento Valley above Sacramento, who consented to accept the apportionments of a Water Master appointed by the State Water Commission. No new water permits were granted by the Commission in this territory.

A further effect of the up-river diversions and the lessened stream flow past Sacramento has been to permit the retrogression of the tides, with reversal of the current and resulting salinity of the river water, many miles further up the rivers than ever known before. This salinity has forced the towns on the lower rivers that pump water directly from the streams to barge water during the late summer months from many miles up stream, while the irrigation of the delta lands is threatened. Further diversion of water from the upper Sacramento it is claimed will imperil and destroy the productivity of the delta region. The upper valley and delta land owners have each perfected organizations preparatory to defending their positions in Court. The city of Antioch, backed by the delta owners, has brought suit for an injunction restraining the rice growers of the upper valley from diverting water for their crops, unless strictly riparian to the streams. This is the preliminary skirmish in a legal battle that, unless checked by a physical solution, will involve hundreds of millions of dollars, and continue for years. Neither side should lose unless the State is to suffer.

Another element entering the problem is the fact that the Sacramento River is a navigable stream and under the control of the War Department. Diversion of water to the detriment of navigation must therefore have the sanction of the Federal government.

Coincidental with this crisis in the Sacramento Valley arising from the growth of rice culture the production of cotton is making rapid strides and assuming large proportions in the San Joaquin Valley, and this combined with a phenomenal increase in fruit culture is putting great pressure on the water resources there. To meet the emergency pumping has been resorted to in both valleys to an undreamed of extent, with a resulting serious lowering of the general water table, and such a draft upon electric power that its use has had to be regulated and prorated under the direction and control of the State Railroad Commission.

The above statements set forth only the high lights of a big situation awaiting treatment. Great numbers of minor problems of irrigation development, in the aggregate large, cannot be touched upon. The entire situation is rendered critical, and in a measure superinduced, by the fact that the season of 1917-18 was one of very scant rainfall and runoff, with resulting abnormal low water conditions during the summer of 1918. This has continued during the years 1919 and 1920, with a cumulative and alarming falling off in stream flow and lowering of the surface and underground reservoirs.

Storage of Flood Waters

The remedies for the most part are storage of flood waters to equalize and increase the summer flow. Through the assistance of the Federal Reclamation Service it is proposed to impound and control the waters of the Colorado River for the irrigation of the entire Imperial Valley. The San Joaquin Valley is being organized into great irrigation and conservancy districts for construction of storage reservoirs on a great scale. Such reservoirs are now proposed on the Kern, Kings, San Joaquin, Merced, Stanislaus and Tuolumne rivers. From each of these projects a large amount of hydro-electric power will be developed. Coming to the Sacramento Valley various solutions are proposed. The War Department has tentatively suggested the canalizing of the Sacramento River with a system of dams and locks that would protect navigation by lifting the summer water level; permit a greater volume of flow to be diverted, and lesson the pumping head on many projects. Private parties have proposed the construction of a huge tidal dam and locks at the upper end of Carquinez Straits, and below the confluence of the Sacramento and San Joaquin rivers, to reservoir the entire network of channels of the delta region and hold back the salt water from the upper rivers during the summer season. Flood storage reservoirs are proposed by public organizations on the Sacramento River in Iron Canon at the upper end of the Sacramento Valley, and in the Fall River Valley to impound the flood waters of the Pitt and Fall rivers, principal tributaries of the Sacramento. The Iron Canon reservoir will back the water up in the channel of the Sacramento River for 25 miles and impound 600,000 acre feet, and the Fall River Valley reservoir will impound 1,000,000 acre feet. Another proposal, now being studied, is to bring the waters of the Klamath River in Oregon through the Siskiyou mountains by tunnel into the headwaters of the Sacramento. The ultimate solution may be in one or more, or in a combination of all, of these suggested plans. In any event the problem is a big one, and much is at stake.

Very active operations are being carried on to meet the power situation. The Edison General Electric Co. and the San Joaquin Valley Light & Power Co., operating in the south and central San Joaquin Valley; the Pacific Gas & Electric Co. and Great Western Power, operating in the north San Joaquin and Sacramento valleys, are spending millions of dollars and rushing through great electric installations aggregating hundreds of thousands of horse power to meet the present and growing demands.

California is facing a great future, and is preparing to lay the foundation for its essential water supply in a big way, and in that preparation the engineer will take a leading part.

AN ENGINEER'S THOUGHTS ON AMERICANIZATION

By John F. Druar, Consulting Engineer, 512 Globe Bldg., St. Paul, Minn.

We Americans have a larger load to carry than we realize in the assimilation of the foreign population immigrating to our shores. Not only should we welcome these new arrivals, but we must take them from the congested areas and distribute them broadcast throughout our land, unless we are to build Italy, Holland, France, Belgium, Hungary, Germany and other nations right up within our borders much the same as Japan and China have been rebuilt in California.

Most of the foreigners immigrating to this country come with families and the rapid birth increase among these people far surpasses the birth rate of the average American family. Consequently, unless we wish to become in the future subservient to some foreign group, we must take pains to distribute the strangers within our gates and so mix them with our rural population and the people of our small towns that their nationality will become subservient to ours. To improve the situation requires far greater thought than we have given the subject. Americanization societies have sprung up all over the country, and they are doing a good work, but we are not hitting the fundamentals as we should.

For example, an immigrant reaches a small inland town. He may be a section hand on the railroad. He naturally wonders how the county is run. He looks about for the representative of government and may see a tobacco-chewing and spitting town marshal who may use him roughly and sometimes maltreat him. He goes to the postoffice, most likely in a dingy general store or in a poor building, at best, probably poorly lighted and ventilated. He gets a poor impression of the government from the start. Naturally his associates on the section, or wherever he works, treat him roughly, meaning perhaps no harm, but this man is looking for kindness. He gets practical jokes, wrong information, he may be robbed, beaten and broken, he becomes suspicious of everyone and fear and hate of authority become ingrained in his nature where willingness and loyalty should be and could be by the proper treatment.

I have given some thought to the improvement of conditions and can see no good reason why a scheme such as I have to suggest could not be put into general practice.

Decentralization of Federal and State Governmental Functions

Our general government at Washington is becoming too centralized and congested, employes fall over themselves. The vast storehouses of indiscriminate records for various departments are so huge it requires thousands of clerks to file and sort them. No one knows how the government is run except those who visit Washington and make an intensive study of the situation and then, permit me to say, it puzzles them.

How then can we expect the foreigner to grasp even a small idea of our system? The answer lies in decentralization of such functions of government as may be distributed throughout the country at large.

Again the state has centralized its government and concentrated every function at the Capitol.

The local municipal government is usually housed poorly in an unkept hall, where records may and may not be available, and where one is not impressed with the power and majesty of the law and order nor of any functions of the government from the small municipality up.

To overcome this situation at once everywhere would be impossible, but to gradually zone the country and carry out a decentralization process in time would be easy. If congress were to pass the necessary laws and the state and municipal authorities were to co-operate, we might be able to save not only immense amounts in the future but we would surely improve our citizenship wonderfully. The basis is small town and rural community service, the binding of the people together for the good of all. In a city, what interest do you have in your next door neighbor or the man down the block? Really not any, and very often you do not know his name or nationality. Are you self-centered or just why is it? When the citizens of the smaller communities become so self-centered, then our nation will be wrecked.

The Decentralization of Industry

It is for us to avoid such a calamity by the proper distribution and education of the masses. It is just as possible now to build a small factory in a small community and operate it at a profit as it was in by-gone days. You do not have to make all the collars of the world in Troy, New York, nor all of the flour of the world in St. Paul. It could be done as well in other communities. Centralization is a crime for it leaves the small town smaller and the large cities more congested than ever so that disease and pestilence can sweep, like a forest fire, through a whole region.

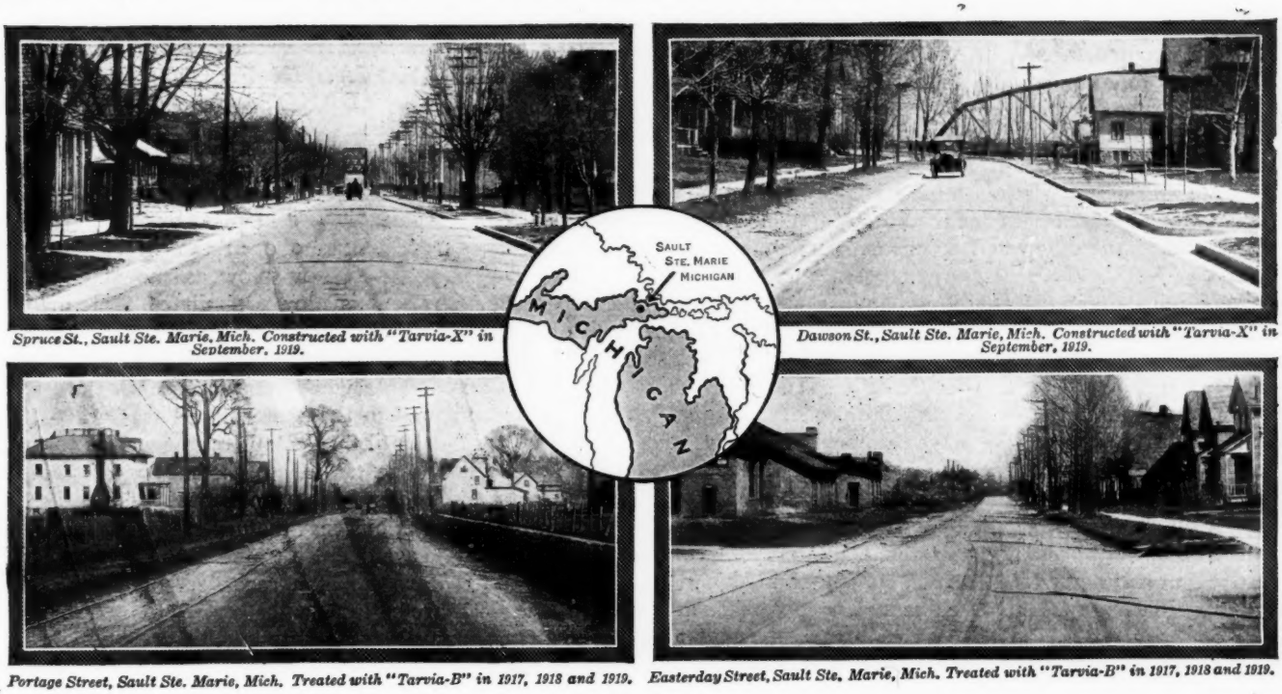
The man of the small town is just as capable as the man of the city. Often I think that his opportunity for concentration makes him more so. He is not distracted from his set purposes and fights his fights alone and unaided. I understand only too well the fight that will have to be made to undo a great many wrongs of government to suppose that anything like the following program can be accomplished in a day, a decade or in a generation but study can be given it and a start can be made.

Who knows but that some governor will start the fight this year with these suggestions as a basis?

A Joint Public Building

To impress the whole population with the power of the people and the power of self-government, I would have each village and small city set aside a city block in or near the center of the town for the purpose of building a joint structure to house such functions of the federal government, the state departments and the city and county governments as might be necessary for the present time or for the future. We should bear in mind the fundamentals of education, and instruction must be given to the masses, for to build and maintain a nation against the perils from without and within the humblest of our people should know the workings of our laws. The possibilities of their communities should be shown them and their pride stimulated.

If a structure were jointly built by government, state and village, I would suggest that it be a substantial building not necessarily ornate but of such a size as to accommodate the postoffice, such federal offices as might be required and sufficient space for an auditorium and space for the local village offices, rest rooms for both



Spruce St., Sault Ste. Marie, Mich. Constructed with "Tarvia-X" in September, 1919.

Dawson St., Sault Ste. Marie, Mich. Constructed with "Tarvia-X" in September, 1919.

Portage Street, Sault Ste. Marie, Mich. Treated with "Tarvia-B" in 1917, 1918 and 1919.

Easterday Street, Sault Ste. Marie, Mich. Treated with "Tarvia-B" in 1917, 1918 and 1919.

Begin by Saving the Roads You Have—

SALVAGE the roads already built—make *them* adequate to handle the traffic—then go ahead with new construction.

With labor and material costs at their present level, this is obviously the only way that highway commissions can hold their own in the fight for good roads.

By the use of Tarvia. the transformation of old macadam and gravel roads into modern highways can be made quickly and cheaply.

Sault Ste. Marie, Mich., is one of the many American cities that have found Tarvia the greatest salvager of water-bound macadam. After careful tests, this city last year treated 80,000 square yards of macadam with "Tarvia-B", and also used 30,000 gallons of "Tarvia-X" in resurfacing worn-out roads and for building new pavements. The photographs reproduced above show the splendid results obtained.

Probably there are old macadam roads in your community which you have considered absolutely worthless but which will still make excellent foundations for new Tarvia pavement tops.

Doubtless there are others which need only proper patching with "Tarvia-KP" and surface treating with "Tarvia-B" to put them in first class shape.

And where macadam roads are in good condition, you will find a simple and inexpensive Tarvia surface treatment all that is required.

Tarvia roads are the logical solution of the good-roads problem, offering smooth, dustless, mudless and traffic-proof pavements at low cost. They are proof against the frosts of winter, the thaws of spring, the heat of summer and the rains of autumn.

The maintenance expense of Tarvia roads is small and the resulting saving soon repays the initial cost.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write our nearest office regarding your road problems, the matter will be given prompt attention.

Tarvia

Preserves Roads—Prevents Dust

Booklets free on request.

Tarvia Auto-tank Sprayer

New York, Cincinnati, Minneapolis, Atlanta, Lebanon, Chicago, Pittsburgh, Dallas, Duluth, Youngstown, Philadelphia, Detroit, Nashville, Salt Lake City, Milwaukee, Toledo, Columbus, Richmond, Latrobe, Bethlehem, Boston, New Orleans, Syracuse, Bangor, Elizabeth, St Louis, Birmingham, Seattle, Washington, Buffalo, Cleveland, Kansas City, Peoria, Johnstown, Baltimore

The Barrett Company

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N.B., Halifax, N.S., Sydney, N.S.

men and women fitted with the best sanitary appliances. Then, too, there should be space for a government and state library of statisticians where all government and state records would be available for reference use.

The time is coming, if it is not already here, when all state and country roads must be patrolled frequently owing to the increase of pleasure cars and motor truck traffic and to the other swifter means of communication.

Government Manager

This joint municipal building could contain barrack room for a joint village, state and government constabulary, properly uniformed and equipped with police power over certain sections. This would be a splendid, efficient and economical means of keeping the peace. Over such an organization should be a government manager who would be especially trained for this work by taking a university or special training course. This man should make such community work his life study and be paid well. He would act as postmaster, community director, statistician and lecturer on special subjects and should be a representative man, divorced from any political party, and one who could advance from stage to stage and from a smaller to a larger community as his own efforts dictated.

This man would have his fingers on the pulse of the community. Statistics of the soil and crops around about should be worked up by him. His advice or the advice of other government departments would be given freely to the farmer, the local manufacturer or business man. A record could be kept of vital statistics, value, size and quantity of dairy products, stock and other products. Government moving pictures of an educational nature could be given, accompanied by lectures on animal husbandry, crop rotation, sanitation, good roads, drainage, small manufactures suited for the rural community and many other interesting subjects.

The time is coming when the small community must become more self-supporting for the congestion of our railroads is such that if finished products can be produced in zones, the railroads can be materially relieved, a more even distribution of freight cars will be the result, the rural community of today will be vastly improved from an industrial, social and economic standpoint. The time has come when we must recognize these facts, and build up our sparsely settled districts and draw some of the urban population into the smaller places. The strength of the nation depends upon such development.

Industrial Development of the Interior

Another point is that the backbone of our country, the Mississippi Valley as well as the Missouri Valley, must be developed with factories, steel mills, foundries and the like so that in event of hostilities with any nation or group of nations, if we were to lose our coast cities, we would still be capable of offering a tremendous defense from drawing our supplies from our inland nation.

Poo poo this danger if you will, but what has occurred in the past may occur in the future, and a chapter of accidents and foreign successes might well place us in a very hazardous corner where all our inland reserves might be called upon to the very limit.

To sum up in a few words, we are as a nation not putting forth our best efforts to draw our foreign population to us and to educate them to the principles of our freedom and to the glory of being wrapped in the folds of the Stars and Stripes.

SNOW REMOVAL IN FARGO, NORTH DAKOTA

To the Editor:

Early in October we had a very heavy snow which practically blocked traffic and stopped business. In considering ways and means to open the streets, we constructed an "A"-shaped snow plow as shown in the accompanying view. This plow is built of 3-in. material with the lower edges lined with steel; it is 2 ft. high with a spread of 16 ft., wide enough to permit two vehicles to pass. Considerable work was accomplished with the snow plow attached to the "caterpillar" tractor.

It was not long until the various organizations throughout this section were taking up the matter of keeeping the streets and roads free from snow. The merchants are always very anxious that the necessary steps be taken to keep the highways open to traffic. A number of cities in this section have gone on record recommending that such steps as are necessary be taken to provide such equipment as may be needed to do this class of work.

The State Automobile Association of North Dakota

CATERPILLAR TRACTOR DRAWING HOME-MADE SNOW PLOW AT FARGO, N. DAKOTA.

has gone on record recommending the adoption of some means of keeping the streets and roads clear of snow during the winter. Farmers favor this suggestion because it means they will be less isolated after a snow fall and merchants favor it because of the increase of business it will bring. If automobiles can be kept running all the year the automobile dealers and garages will be able to keep their men employed twelve months in the year, whereas at present it is often necessary to cut down the force because of lack of business.

With good roads comes the necessity of keeping them open for traffic twelve months in the year. It is not expected that we shall invest our money in permanent highways and allow the snow to impede traffic for five months each year.

The snow plow we used was built rather hurriedly, but it did very satisfactory work. We believe that in another season it can be greatly improved upon, and if proper attention is given the roads upon getting our first snow fall we will be able to keep the roads open and in such condition as will permit the traffic to pass in the regular way.

Very truly yours,

H. P. Smith,

Fargo, N. D., April 16, 1920.

WATER WORKS SECTION

METHOD EMPLOYED IN CLOSING A LEAK UNDER A DAM

By W. D. P. Warren, of Miller, Holbrook, Warren & Co., Civil Engineers, Millikin Bldg., Decatur, Ill.

A problem often presented to engineers is that of preventing the destruction of dams, abutments or other similar structures from the undermining action of water.

Singularly enough, little is given in our current journals on this subject, and yet some knowledge along this line will frequently prevent the loss of very important engineering structures.

As a member of the firm of Miller, Holbrook, Warren & Co., Consulting Engineers for the City of Decatur, Illinois, during 1919, the writer was called upon to investigate a leak under the concrete dam in the Sangamon River, near the city pumping station. As the city water supply depended entirely on this structure, it is readily seen that its loss meant a great deal to the 45,000 inhabitants of Decatur.

In this connection, it is interesting to note that the Sangamon River at this point has a water shed area of over 800 square miles, the normal flow having afforded sufficient water during recent years to supply the needs of the city. The concrete dam in the river was originally built about 10 ft. high, 100 ft. long, and served to impound water only in the main channel of the river. At the present time the city has under construction a large dam which will provide an impounding reservoir covering about 4,000 acres.

The concrete dam in the channel of the river was built about 12 years ago, and consists of a gravity section probably 100 ft. long, with wings at each end extending about 2 ft. above the spill-way level, and set at about the elevation of the natural ground in the valley proper, thus permitting the water in flood time to spread over the entire structure as well as the valley.

The concrete dam referred to was built on rather pervious soil, overlying a sand and gravel deposit probably 50 ft. in depth, the dam being supported by piling and solid sheeting being driven into the bed of the river to prevent any underflow.

During the season of 1918, a serious break occurred under the south wing of the dam, and as the sheeting under the main structure did not extend under this wing, the water quickly tore a large opening under the wing, finally undermining it and entirely washing away its outer end. This required the construction of an extension to the spillway section and the construction of a new wing, farther to the south, on solid ground.

At the time of this break in 1918, the writer was not connected with the city, so is unable to give information as to the rapidity with which the wing failed, or to state the manner in which it was undertaken to prevent its destruction, however, the fact that an expense of about $36,000 was incurred because of its destruction is interesting in considering the problem as presented by a somewhat similar occurrence again in 1919.

In July 1919, Mr. Harry Ruthrauff, Water Works Commissioner, requested the writer to accompany him to the site of the dam to investigate a leak which had been reported there. Upon arrival we found a crew of men endeavoring to stop the leak by unloading heavy stones about the place where water was passing under the dam. Also we found about 6 ins. of water passing over the spillway, with water at one point below the dam coming up from under the structure with such force that it threw sand and gravel 1½ ft., or more, above the level of water below the dam. In other words, there appeared to be a powerful current sweeping under the dam, cutting a hole which might at any time cause the entire current of the river to sweep under the structure as it had done during the previous year when the south wing had been undermined.

The leak seemed to be in the vicinity of the old south wing, where the new spillway section joined it. However, as many wooden piling and heavy sheet piling had been left in place after the construction of the previous year, it was very difficult to determine any definite point of leakage.

Upon brief investigation it was learned that sheeting had been driven under the new spillway section, as well as the old one and that upon completing the work the previous season, the opening under the old south wing had been refilled, the filling however, having been placed without putting in sheeting or an impervious wall of any character. Thus, as we later definitely determined, the leak was under the portion of the old south wing still remaining, this wing extending about 10 ft. up stream from its junction with the spillway, and about 15 ft. down stream, offering an opening about 3 ft. wide upon the washing out of the earth filling underneath.

The force with which the sand and gravel were thrown above the water, and the area over which this occurred, probably 10 sq. ft., indicated that the time for prompt action was at hand. Commissioner Ruthrauff, fully appreciating the danger to the structure, advised that he wanted the undivided attention of the writer on this work until the leak was stopped and stated he was ready to furnish any material and labor that we considered necessary.

Having in mind the repair work of the previous season and its cost of $36,000 which had been made a campaign issue in the spring election of 1919, we doubtless created some surprise when we recommended laying a mat of green willow trees about the old south wing, and covering these over with gravel, then sand and clay.

This was essentially the plan followed, and later work on this area so covered, disclosed the fact that at some

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, Chicago, Ill., September, 1920.

points an absolutely impervious mat had been formed by placing such material to a thickness of less than 2 ft.

The small green willows were cut from the bank at the site of the dam, tied in bundles about 10 ins. in diameter and 6 to 8 ft. long, weighted at each end with heavy stones and sunk about the old wing. Upon this mat which was very hard to spread because of old sheeting, piling, and large rocks already thrown in at this point, gravel ranging in size from 1 to 4 ins. was placed and over this a mixture of sand and gravel, about 80 per cent sand, was then laid. This was covered over with clay having a good percentage of sand, secured in the vicinity of the structure. The fact that leakage was occurring under the full length of the remaining portion of the old wing, both above and below the dam, and that the old piling, rocks, etc., held the willow matting up at places, required the covering of a much larger area than might otherwise have been necessary.

Another difficulty was experienced due to the rise of the water in the river, requiring the transporting of all materials from the banks in a cumbersome flat boat.

After several days enough material had been placed to form a coffer dam above the spillway and about the old wing, and by gradually taking out the large stones, some of which were 1 ft. to 2 ft. in length, the impervious material had been worked down sufficiently under the old wing to reduce the underflow greatly.

The sand and water, however, continued to rise about the portion of the wing below the spillway, indicating that there was not sufficient material of proper size getting under the wing to close the opening. This condition suggested a plan of placing the willow mat over the entire area about the down stream end of the old wing, and covering it with heavy stones. Accordingly this was done, resulting in the decreased loss of material which had been passing away under the old wing from the up stream side.

In doing this work, it was borne in mind that there had been a mine subsidence in this area due to removal of the coal at a depth of over 600 ft. and that settlement might occur in the future disturbing any rigid construction, also that if the dam could be maintained for a period of several years, the new impounding reservoir would then be complete.

The work outlined above required several hundred cubic yards of material and a force of five to 10 men over a period of a week or more, but it was considered necessary to place sufficient material above the spillway and about the old wing so that it would gradually settle into the opening and thoroughly close it, being stopped by the placing of the mat on the down stream side.

Before leaving the work, it was finally found that the material placed above the dam was sufficiently solid to act as a coffer dam, and men were then set to work to go down to the opening under the old wing at its intersection with the spillway section, taking out the gravel, sand and willows and finally removing the large stones which had thoroughly prevented the willows from getting into the real opening under the wing. This opening was then carefully sealed and the material replaced, all material above the spillway and about the wing being then covered over with a course of heavy stone to prevent its being carried out during flood time.

The mat below the spillway, covered with heavy stones, serves to check all fine material working through from the upstream side.

The plan followed in this work was approved by Mr. F. D. Holbrook of our firm, who has spent many years in charge of lock and dam construction on the Ohio River. Mr. Holbrook has found the use of willows very effective is stopping leaks in coffer dams and other structures.

In choosing materials to place over the willow matting, consideration should be given to the proportions generally specified for puddle wall construction.

Col. John T. Fanning, M. Am. Soc. C. E., recommends the following proportions: 0.2 cu. yds. of clay, 0.15 yd. of sand, 0.33 yd. of fine gravel, and 1.00 cu. yd. of coarse gravel. The value of using fine material on the upstream side is readily understood, as such material tends to silt all small openings rapidly between the sand and gravel particles, and form an impervious wall.

The method followed in closing the leak under the dam at Decatur secured the desired result and the cost of the work was extremely small considering the cost of the previous season and the importance of the structure.

The plan of using inexpensive materials, available at the site of the structure involves the employment of nature's own resources for the benefit of mankind, and for this reason should be worthy of consideration.

INCREASING ECONOMY OF ST. LOUIS WATER WORKS PUMPING PLANTS

By Leonard A. Day, Engineer in Charge, Operating Section, Water Division, 34 E. Grand Ave., St. Louis, Mo.

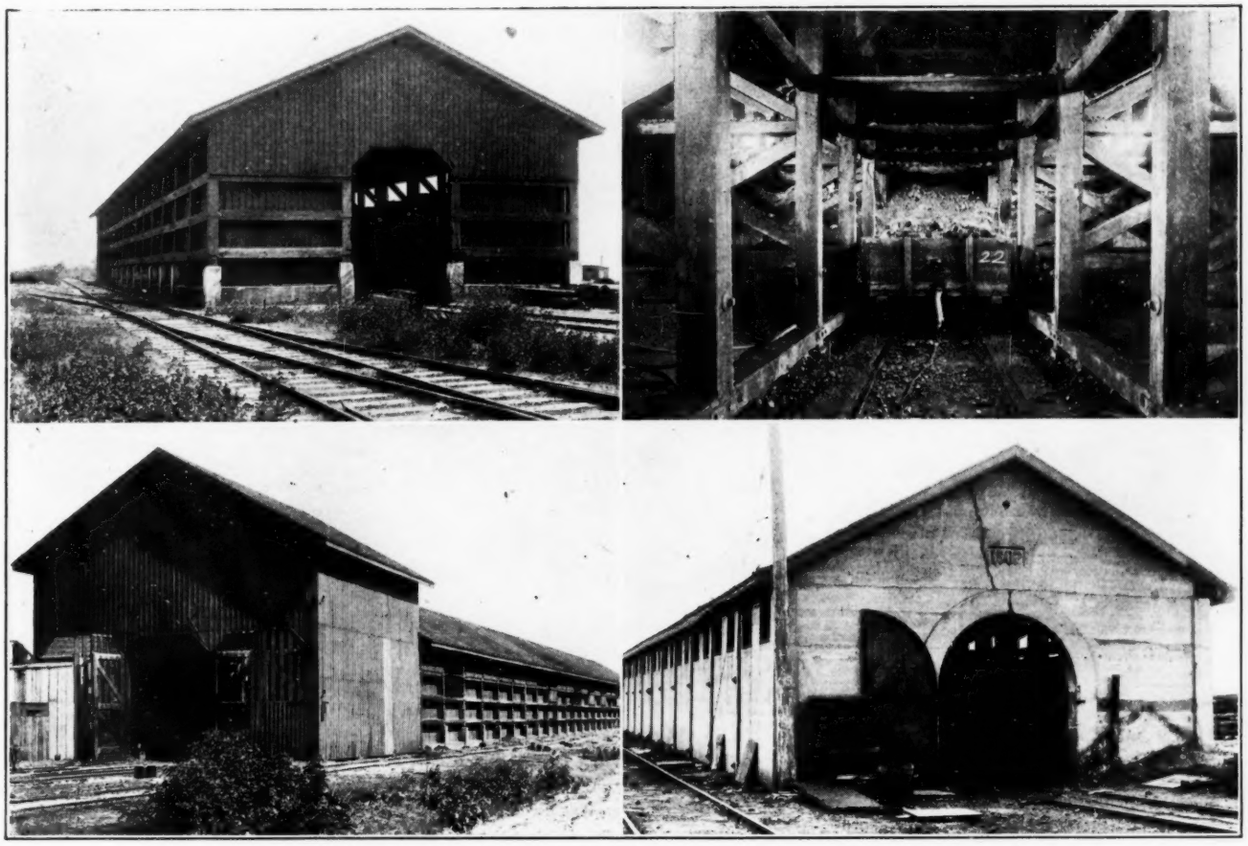
Inasmuch as the economy of pumping stations from a heat saving standpoint deals directly with coal, and owing to the rapid increase in cost of coal throughout the country, it became imperative on the part of the engineers of the St. Louis water department to make a thorough investigation of the heat losses existing in the respective plants with a view to reducing the losses to the lowest possible minimum. When it is considered the coal cost constitutes probably 40 per cent. of the total pumping cost and that in the average pumping plants throughout the country not more than 10 per cent. of the heat value in coal is utilized, it is easy to see that the more economical use of coal is highly profitable.

Storing Coal

In passing it would be well to mention our experience in storing coal. We have found that practically all grades of bituminous coal can be stored for an indefinite period without any material loss in its heat value, if proper precautions are taken in storing it. The Water Department of the City of St. Louis is provided with storage capacity of 15,400 tons, which will maintain a supply sufficient to last over a period of 60 days. Notwithstanding the fact that we are in close proximity to the Illinois coal fields, the wisdom on the part of the Department in maintaining this liberal supply for emergency use has manifested itself on several occasions since the beginning of the war.

The coal stored is known as 6-in. screened lump. It is piled 16 to 18 ft. high in sheds. Heat value determinations have been made on this coal after having been in storage for a period of 10 years, the results of which show no appreciable heat loss due to storing. Naturally

coal loses some of its moisture and this loss tends to compensate for the heat loss due to some of the volatile gases being set free. We do not attempt to store Illinois screenings for any length of time. We have, however, stored 2-in. Illinois screenings for one year, containing about 45 per cent. by weight of Duff. By Duff is meant coal that will pass through a screen having circular perforations ¼-in. in diameter. This coal showed no signs of heating and was placed in a pile about 6 ft. high in the open air with no protection from rain or snow. In general it has been our experience that all bituminous coal free from fines or Duff can be stored for an indefinite period without appreciable heat loss, it being preferable to store sized lump coal and in storing it the coal should be placed with the idea of minimizing breakage.



VIEWS OF COAL STORAGE SHEDS OF ST. LOUIS WATER WORKS.
Top Row: Fig. 1—Chain of Rocks Shed. Fig. 2—Typical Interior of Coal Storage Sheds. Bottom Row: Fig. 3—Coal Storage Shed at Baden Station. Fig. 4—Shed at Bissell's Point Station.

Chain Grate Stoker

Returning to the consideration of the economical use of coals. According to our experience, the chain grate type of stoker is best suited for burning the low-grade clinkering coals, such as is found in the Illinois coal fields within a radius of 25 miles from St. Louis. This type of stoker is capable of meeting any peak load up to 100 per cent. above normal boiler rating. It is simple in construction, easy to repair, it can be operated under all load conditions with natural draft, thereby greatly simplifying the boiler room equipment, and can be operated efficiently on light loads and overloads. Its first cost is about half of that of the forced draft underfeed type. A ratio of 1 sq. ft. of grate surface to 48 sq. ft. of boiler heating surface has given the best results, considering our loads and coals.

Furnace Arch and Combustion Chamber

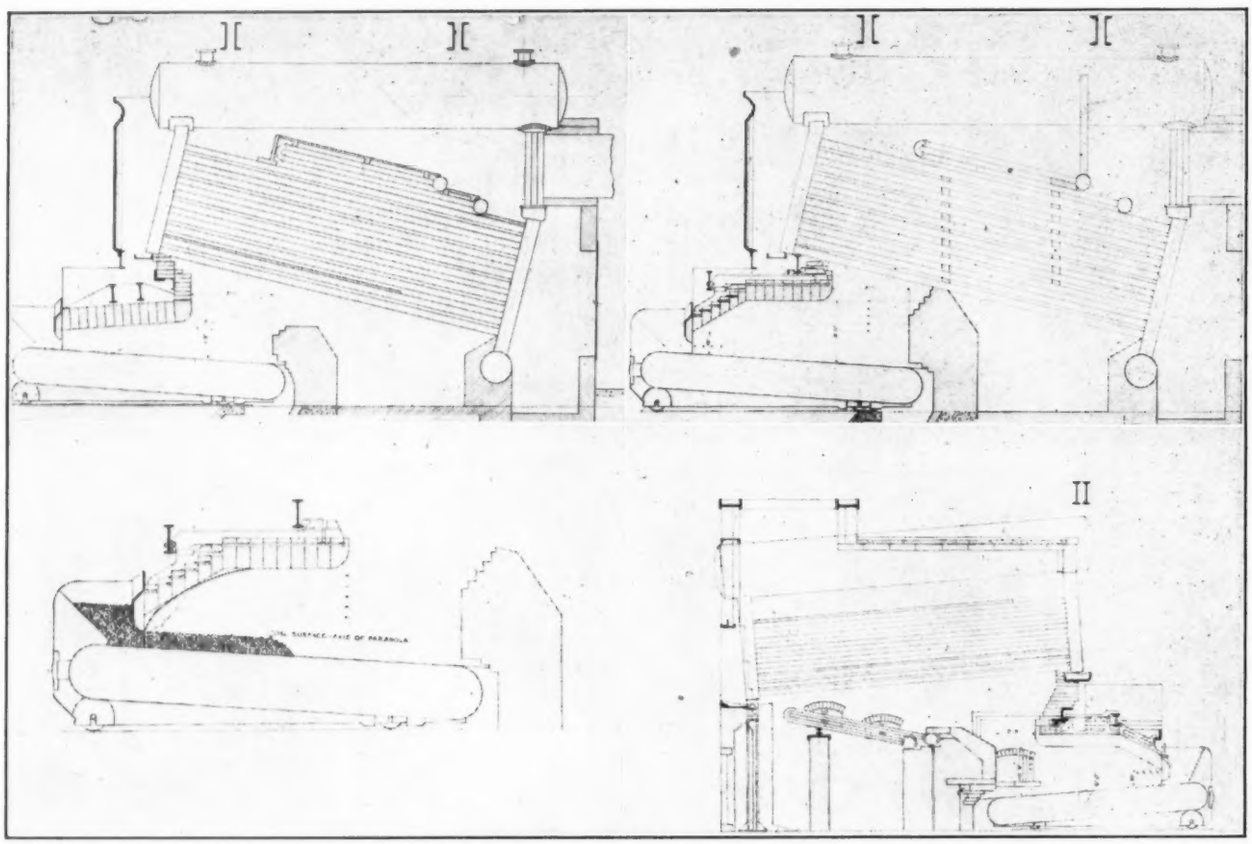
The coal is 2-in. Southern Illinois screenings, having an average heat value of 10300 B. T. U., with from 20 to 25 per cent. ash. In addition to the proper size grate our experience shows that a properly designed furnace arch and a combustion chamber with sufficient volume to allow complete combustion will add greatly to the efficiency and capacity of the boilers. The first chain grate stokers we installed were at the Chain of Rocks plant in 1914. The stokers were placed under 6 National Water tube boilers, each of 360 H. P., and two O'Brien Water tube boilers, each of 250 H. P. capacity. The boilers were set 7 ft. from the floor, and the arches were set 11 ins. from the grate at the front and 22 ins. from the grate at the rear, the arch being 6 ft. 5 ins. long. The original arch was set according to the designs of the stoker contractor. The boilers were arranged with horizontal baffles, the lower baffle being placed on the second row of tubes. The average boiler efficiency under operating conditions with this setting was approximately 58 per cent. and it was difficult to obtain an overload of 25 percent. Investigations were started at this station with a view of increasing the boiler efficiency and capacity. We have found that a stoker arch to function properly should be set high enough over the grate to allow the volatile gases to be distilled off without being crowded under the arch, also the shape of the arch should be such as to allow the heat from the bridge wall to be focused on the coal as it enters the

furnace; this is necessary to start combustion in as short a time after the coal leaves the feed gate as possible so that every available foot of grate surface is utilized for burning coal. By referring to Fig. 5, which shows the original arch, it will be apparent, that from the standpoint of obtaining a large liberating volume under the arch and an efficient shape of the roof so as to obtain the maximum benefits of heat reflection coming from the bridge wall, that this arch did not function properly.

Referring to the lines indicating heat rays, it will be observed that this arch does not permit a concentration of heat at a point where a maximum concentration is desired, namely, at the point of ignition. These objectionable features have been overcome by the new design of arch shown on Fig. 6.

With the old type arch on a capacity test run by the stoker contractor, an evaporation of 15,770 lbs. of steam per hour was maintained for ten hours. With the new style arch an evaporation of 17,140 lbs. of steam per hour was generated for five hours. The former represents an overload of 38 per cent., while the latter represents an overload of 60 per cent. At the same time the average boiler efficiency was increased from 58 per cent. to 63 per cent., or a gain in efficiency of approximately 9 per cent. After all boilers will have been equipped with the new arch, it is estimated that the saving in annual coal cost will amount to about $5,000 at this station.

A similar improvement in capacity and efficiency was made at the Bissell's Point Station. The boilers at this station are set with the front water leg 6½ ft. above the



SOME OLD AND NEW BOILER SETTINGS OF THE ST. LOUIS WATER WORKS. TOP ROW: FIG. 5—CROSS SECTION THROUGH OLD CHAIN OF ROCKS BOILER SETTING. FIG. 6—NEW CHAIN OF ROCKS BOILER SETTING. BOTTOM ROW: FIG. 7—PARABOLA SUPERIMPOSED ON NEW ARCH; FIG. 8—CROSS SECTION THROUGH BADEN BOILER SETTING.

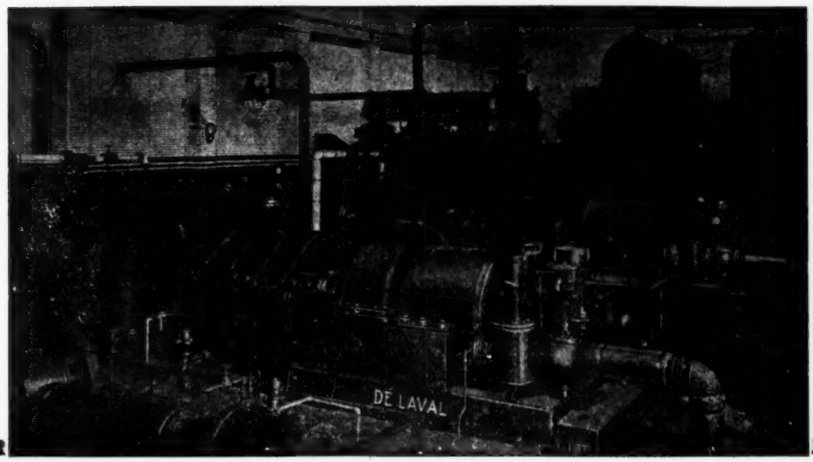
In this setting, the distance from the floor to the front water leg remains 7 ft., being determined by the original setting of the boiler. The arches are set 12 ins. from the grate at the front end, rise rapidly to a hip, and are 36 ins. high at the rear. The length of the arch is 6½ ft.

This arch has a better concentration of heat rays near the feed gate, the rays being reflected from the bridge wall, than the one shown in Fig. 5, due to our obtaining a contour which approximates the curve of a parabola, in which curve all reflected heat rays would concentrate at the focus. To illustrate, Fig. 7 shows a parabolic curve superimposed on the improved arch.

Effect of Arch Shape

Comparative tests made before and after the change in the arch shape resulted in the following:

floor line. The original arches were sprung transversely across the grate 9 ins. above the grate at the hip, rising to 18 ins. above the grate at the center. Longitudinally the arch was parallel to the grate. This type of arch, that is, in respect to the low height above the grate, was the common practice among chain grate stoker builders up to within but a few years past. The arch was removed and replaced with a new type of flat arch, which is 12 to 13 ins. above the grate at the feed gate, and rises straight, without a hip, to 30 ins. above the grate at the rear end. The length is 7 ft. It was not possible to construct a hipped arch at this station because of the limitation of the low setting. However, a good saving was effected for the reason that prior to the change in arch design, it was only possible to burn crushed egg or lump coal at this station, due to the low arches, which did not affect the proper



Two De Laval geared turbine-driven pumping units installed for the City of Philadelphia, each rated at 22,000,000 gal. per day, 355 head.

De Laval Geared Turbine-Driven Centrifugal Pumps at Philadelphia

The history of De Laval Steam-turbine-driven Centrifugal Pumps in Philadelphia is representative of the progress which De Laval pumps are making in water-works plants throughout the country.

In 1909, the City of Philadelphia placed a contract for a De Laval steam-turbine-driven centrifugal pump to deliver 50,000,000 gal. per day against a total head of 50 ft. This pump raises water from the Delaware River to the Torresdale Filtration Plant.

Subsequently, two De Laval steam-turbine-driven units, each of 22,000,000 gal. per day capacity against 335 ft. head, were placed in operation at the Belmont Pumping Station.

At the Lardner's Point Station, a De Laval geared steam-turbine-driven pump of 35,000,000 gal. per day capacity against 201 ft. head has been installed.

At the Queen Lane Station a unit consisting of a De Laval turbine driving two 24 in. centrifugal pumps in series is used to deliver 25,000,000 gal. per day against 279 ft. head.

Recently orders have been placed for four De Laval geared turbine-driven centrifugal pumps of a normal capacity of 40,000,000 gal. per day each against a total head of 275 ft. to be installed in the Queen Lane Station. These are probably the largest capacity water-works pumping units ever constructed and will replace 4 triple-expansion reciprocating pumping engines. These pumping units will have a maximum capacity of 48,000,000 gal. per day each.

The reasons for the unparalleled success of De Laval Geared-Steam-Turbine-Driven Centrifugal Pumps in water-works service, are, first, their reliability and, second, their unequaled overall economy.

They pump water at the least cost, when all costs, including fuel, labor, supplies and capital charges, are taken into account.

Our special Water Works Book tells how water-works pumping problems have been solved in numerous cities throughout the United States and Canada. We would gladly send you a copy upon request. Ask for Catalog W67.

139

DE LAVAL STEAM TURBINE CO.

TRENTON, NEW JERSEY

ignition with the lower grades of screenings. The new designed arch has resulted in our being able to burn the lower grades of screenings successfully, and obtain the same evaporation per pound of coal with screenings as with the crushed egg and lump coals, thereby resulting in a saving in the price of coal of about 18 per cent. This 18 per cent. saving in the price of coal when applied to our last year's coal cost at this station, amounts to an annual saving in coal cost of about $10,000. Also after all the boilers at this station were equipped with the new type arch, the average overall rating of the boiler room rose from 90 to 115 per cent., even with the use of a lower grade of coal.

Although we realized after the new arch was designed, that the setting was not perfect, the boilers being too low, yet even with the low setting the arch has given the improvement in capacity and efficiency mentioned above, permitting one boiler to be taken off of the line.

Elimination of Objectionable Features

The results of experience with the two installations from the standpoint of their objectionable features as previously outlined, led us to adopt in the installation of new boilers at the Baden plant, a setting in which we have embodied a construction which we believe eliminates all objectionable features found by previous experience.

Fig. 8 shows a cross section through the boiler setting. In this setting the arch is similar to that of the new arch for the Chain of Rocks Station, the distance at the feed gate above the grate is 10 ins., rising rapidly to a hip, and is 34 ins. above the grate at the rear. The length of the arch is 7 ft. The height of the front water leg above the floor is 9 ft., this height providing a larger combustion chamber than in the previous settings, thereby obtaining a more thorough mixing of the gases and oxygen and providing a relatively longer gas travel, all of which is necessary for the efficient burning of coal at high rates of combustion. The evaporation at this station averages 6½ lbs. of water per pound of coal at a boiler room efficiency of 66 per cent. and comparing this performance with that of the other stations when the old type of settings prevailed shows a saving of about 13.8 per cent. in coal.

Results of Rebuilding the Arches

As has been previously stated, the overall boiler efficiency of the other two stations is 63 per cent. with the improved arch, while that at the Baden station, with practically the same style arch as was adopted at the other stations, shows an overall boiler efficiency of 66 per cent. This increase of 3 per cent. in efficiency or a gain of 4.8 per cent. may be attributed to the higher boiler setting, namely, 9 ft. instead of 7 ft., which prevails at the other two stations. In other words, by our setting the boilers 2 ft. higher at the Baden station we show a gain of 4.8 per cent. in overall boiler efficiency, and this gain when computed on an annual cost of coal at this station amounts to $3,000 annually.

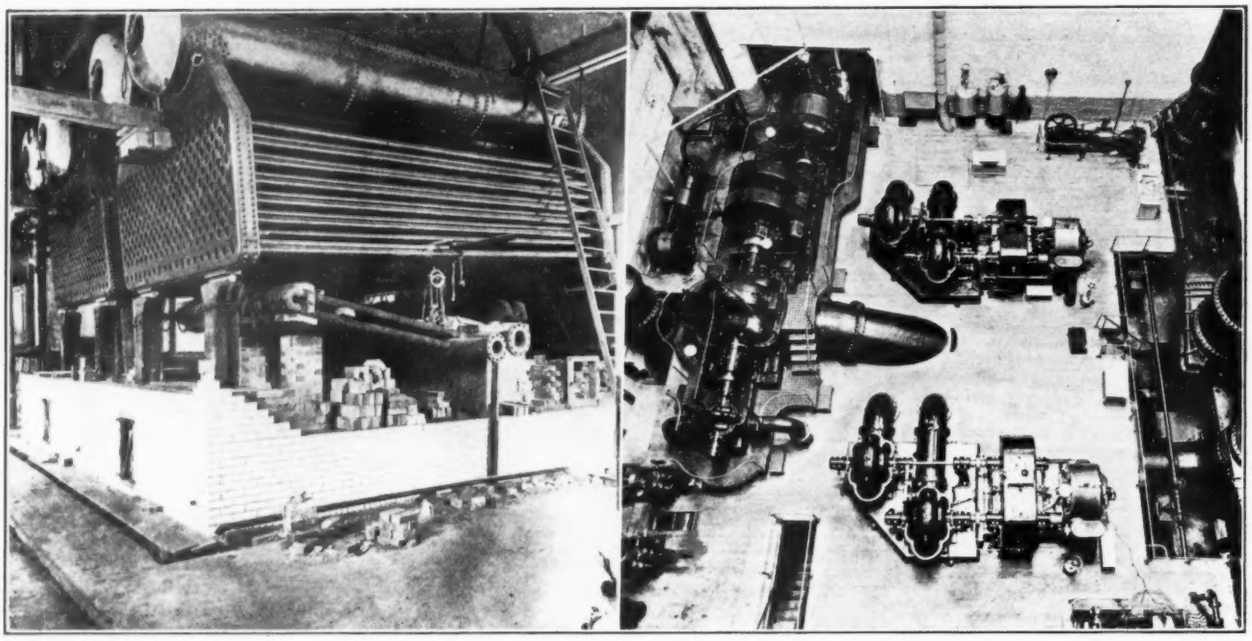


FIG. 9—BOILER SETTING, BADEN STATION, SHOWING SUPER-HEATERS IN COMBUSTION CHAMBER. FIG. 12—STEAM TURBINE DRIVEN CENTRIFUGAL PUMPS IN MIDDLE PIT, CHAIN OF ROCKS STATION, ST. LOUIS WATER WORKS.

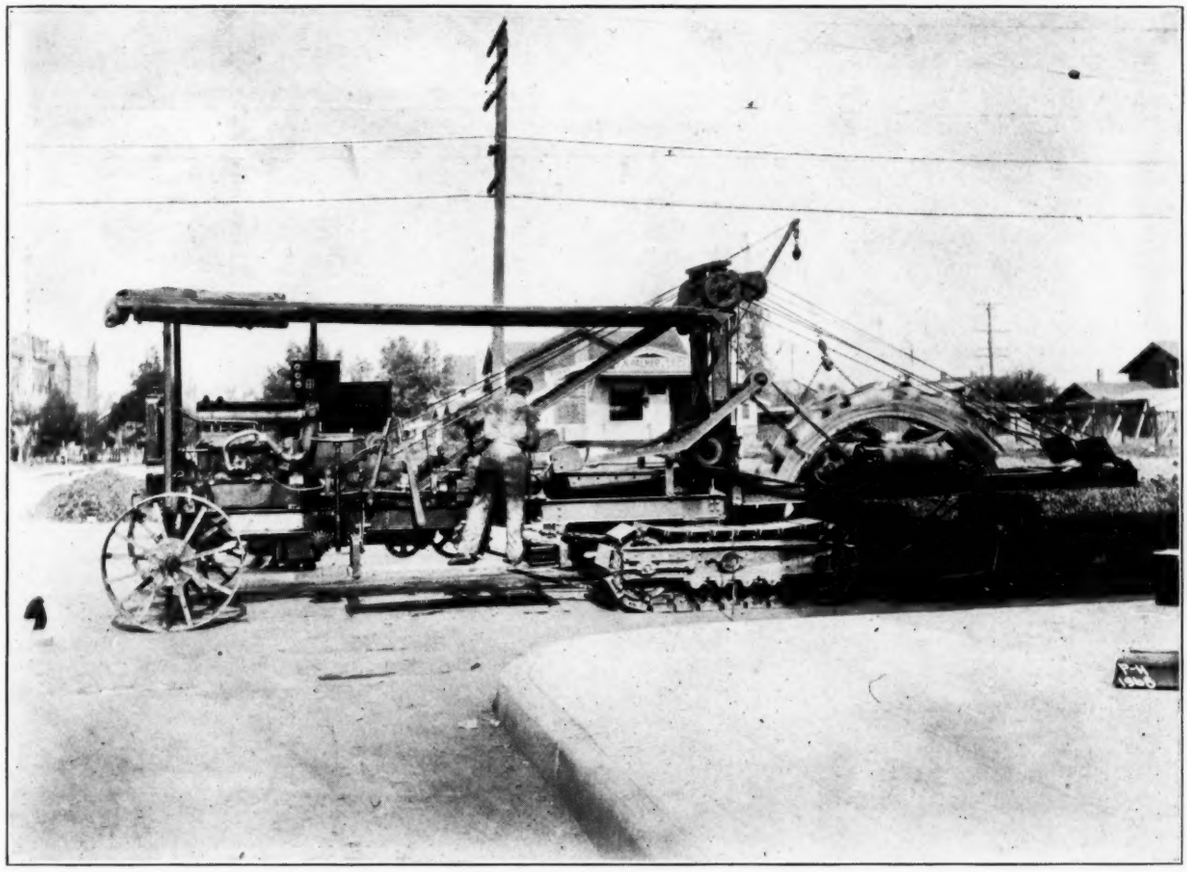
An operating overall boiler room efficiency of 66 per cent. using Southern Illinois screenings, of 10300 B. T. U. per pound, and meeting a variable daily load, may be considered as good as can be expected from this type of boiler room installation.

Our actual cost of rebuilding the arches at the Chain of Rocks and Bissell's Point stations amounted to about $300 per arch, or a total of $4,200, while the saving in coal effected due to these changes amounts to approximately $15,000 per year. The entire work of rebuilding the arches was paid for in 3½ months.

These gains are principally due to the improvement in furnace design, but part of the saving in coal must be credited to improvements made in our boiler baffling.

Improvements in Boiler Baffling

Boiler baffling should be so placed as to force the gases into contact with all parts of the tube bank. In the older Heine type of settings of our plants the lower



Wheel Type P & H Excavator Cutting a Pipe Line Trench.

Pipe Line and Conduit Trenching

THE WHEEL Type P & H Excavator is especially adapted to pipe-line, telephone or wire conduit, and gas main excavation. Its comparatively light weight (the No. 122 K C weighs 19,500 lbs.) permits its use where the land is rough or swampy; its width (10 ft. 7 ins.) is not such as to block a road; and it operates on a convenient form of fuel—gasoline, kerosene, or distillate. Built in four sizes, according to depth and width of trench.

This machine will cut trenches from 15 to 28 ins. wide and from 54 to 90 ins. deep, and the trench may be either straight or curved.

Cost of trenching is reduced to the lowest point, as this is a truly one-man machine.

Whether the work is the average easy job, or one calling for exceptional excavator strength, this Wheel Type P & H Excavator will work rapidly. It has established performance records that has won leadership for quick, cheap and accurate trenching in any kind of material in which an excavator can be operated.

All necessary adjustments are quickly made, for this excavator is especially designed (and perfected under severe conditions) to cut pipe line and conduit trenches.

Ask for Descriptive Bulletin IX.

Pawling & Harnischfeger Co.

EST. 1884

MILWAUKEE, WISCONSIN

Church Street, New York
Stephen Gerard Building, Philadelphia
Whitney Central Building, New Orleans, La.
Fidelity Building, Pittsburgh, Pa.
Monadnock Block, Chicago, Ill.
Yeon Bldg., Portland, Oregon
Central Building, Los Angeles
Monadnock Bldg., San Francisco
L. C. Smith Building, Seattle, Wash.

"You see them wherever you go, and they go wherever you see them."

P&H — excavators — back-fillers - tampers

baffle was made up of box tile on the lower row of tubes and the upper baffle was 13 tubes above on the top row of tubes. The opening in the lower baffle was in some cases as much as 60 ins. from the rear water leg. The path of the gases in this type of boiler was diagonally upward through the tubes, leaving the rear water leg and the tube ends near it untouched by the hottest gases, and leaving a dead triangular pocket at the bottom of the front water leg.

By eliminating the box tile on the lower row of tubes and placing a specially designed tile on the third row of tubes, and also reducing the opening in the lower baffle from 60 ins. to 42 ins., we reduced the flue temperature from an average of 650 degrees F. to 550 degrees F.

It will be apparent from Fig. 8 that the velocity of the gases is higher through the tubes, thereby reducing the insulating effect of the film of idle gas around the tubes and resulting in a better heat absorption. It will also be apparent that the bottom rows of tubes are now exposed to the radiant heat of the flames; thus by raising the baffle tile onto the third row of tubes the gases are crowded into more intimate contact with the tubes, dead pockets in the passes are destroyed, and the lower row of tubes, by absorbing the radiant heat of the flames, tend to lower the temperature of the surrounding walls of the combustion chamber, which in turn tends to increase the life of the setting.

When it is remembered that roughly there is a gain of 1 per cent. in boiler efficiency for every 25 degrees F. reduction in flue temperature, it will be seen that there was an approximate gain of 4 per cent. in efficiency for the 100 degrees F. drop just mentioned, a gain effected by merely placing the boiler baffling into a better location and at a negligibly small cost.

Simultaneously with the installation of chain grate stokers, superheaters were installed in our boiler settings. For determining the size of superheaters, accurate gas temperatures were taken at the place where the superheaters were to be located, and the steam load and firing conditions noted simultaneously as an aid to the manufacturer of the superheater arriving at its proper size.

In the case of horizontally baffled boilers, our superheaters are located in the combustion chambers back of the bridge wall, and in the vertically baffled boilers, the superheaters are located under the shell between the first and second pass. Although the location behind the bridge wall is apparently a severe location, yet it has been our experience that if the superheaters are not within the direct path of the flame, they show no effects of the heat, and promise a long life. The advantages of the location in the combustion chamber, are, a smaller superheater and greater accessibility.

Use of Superheated Steam

The use of superheated steam at all of our plants has proven to be one of the greatest factors in increasing the efficiency of the engine rooms.

Superheated steam in the cylinder of a steam engine transfers heat to the cylinder walls, but instead of condensation occurring on contact as with saturated steam, the superheat must first be withdrawn. Superheated steam maintains a higher cylinder wall temperature and if superheating is carried far enough, condensation can be delayed until after cut-off and even until expansion is partly completed. Also the specific volume of superheated steam is greater than that of saturated steam and this increase in specific volume, the pressure being constant, diminishes the weight of steam to the engine and has an influence on the economy gain, as has also the lower thermal conductivity of superheated in comparison with saturated steam.

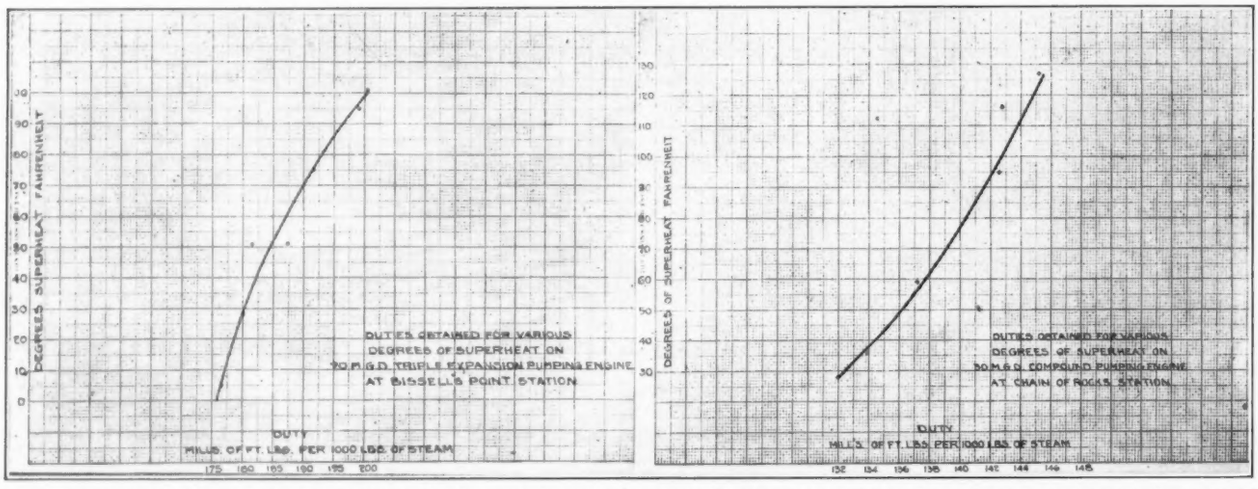

DEGREES SUPERHEAT FAHRENHEIT
DUTIES OBTAINED FOR VARIOUS DEGREES OF SUPERHEAT ON 20 M.G.D. TRIPLE EXPANSION PUMPING ENGINE AT BISSELL'S POINT STATION
DUTY
MILLS. OF FT. LBS. PER 1000 LBS. OF STEAM
DEGREES OF SUPERHEAT FAHRENHEIT
DUTIES OBTAINED FOR VARIOUS DEGREES OF SUPERHEAT ON 30 M.G.D. COMPOUND PUMPING ENGINE AT CHAIN OF ROCKS STATION.
DUTY
MILLS. OF FT. LBS. PER 1000 LBS. OF STEAM

FIG. 10—DUTIES OBTAINED FOR VARIOUS DEGREES OF SUPERHEAT OVER 20 M. G. D. TRIPLE EXPANSION PUMPING ENGINE AT BISSELL'S POINT STATION. FIG. 11—DUTIES OBTAINED FOR VARIOUS DEGREES OF SUPERHEAT ON 30 M. G. D. COMPOUND PUMPING ENGINE AT CHAIN OF ROCKS STATION.

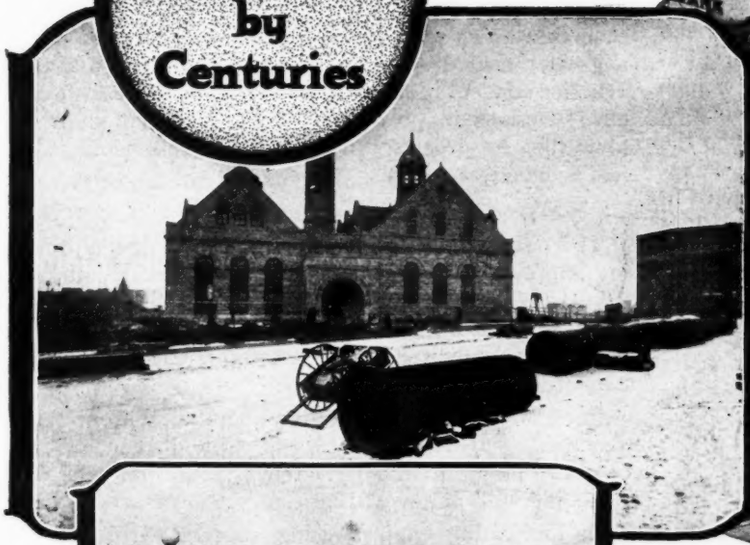
The Water Division has made tests on the effects of superheated steam on triple expansion and on compound pumping engines. The triple expansion engines, which pump against a head of 85 to 125 lbs. pressure and whose capacities vary from 15 to 20 M. G. D., showed a saving for various degrees of superheat as shown in Fig. 10.

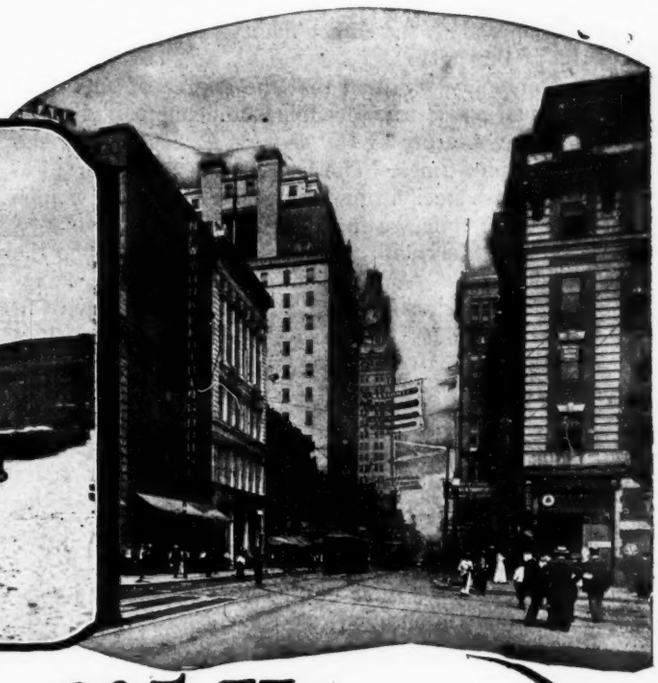
The steam saving for 100 degrees superheat amounted to 12.1 per cent., while the saving in coal amounted to 7.5 per cent.

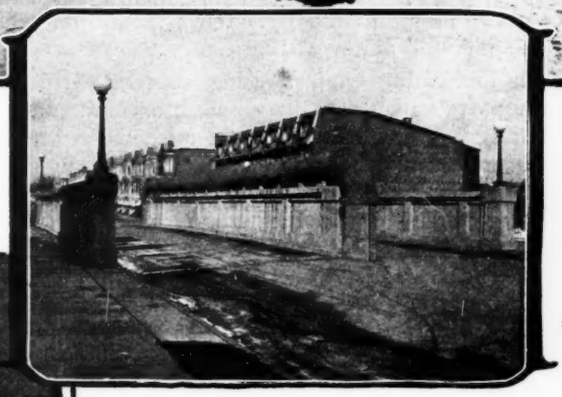
The compound pumping engines, which pump against a maximum head of 65 ft. or about 28 lbs. pressure, and whose nominal capacity is 30 M. G. D., showed a saving for various degrees of superheat as shown in Fig. 11.

The steam saving for 100 degrees superheat amounted to 17.3 per cent., while the saving in coal amounted to 14.1 per cent. The saving in coal due to the introduction

Service Measured by Centuries







115 Years Service in the Monumental City

BALTIMORE has reason to be proud of her water systems, both in the city proper and annexed territory. Practically all of the 1550, or more, miles of pipe now in use (except some high pressure mains) is Cast Iron, the first installation dating back to 1805.

A recent report of the National Board of Fire Underwriters on the Baltimore water supply says—"Repairs have been made to the * * * portion of the * * * conduit which have reduced the leakage considerably, but it is reported that during the winter leakage still continues."

The portion of conduit referred to, is *not* Cast Iron.

Handsome cloth bound book—"Pipe and The Public Welfare" sent on request

The Cast Iron Pipe Publicity Bureau
1 BROADWAY, NEW YORK

CAST IRON PIPE

of superheated steam into our Chain of Rocks Station has been sufficient to pay for the superheaters in about 3½ years. The life of a superheater when the elements are not exposed to the direct flame, should be equal to the life of the boilers.

It is commonly accepted that the degree of superheat for the usual equipment of engines and pumps is limited by a total temperature of 500 degrees F., especially when using cast iron fittings. The Department has resorted to the use of cast steel fittings and valves on all new pipe work. At the time we installed the new pipe work, it was done not solely with the idea in view of meeting the total temperatures of the superheated steam which we intended to use, but also to insure more reliable service in all of our pipe lines than cast iron fittings and valves would give. We have, however, in one of our plants still in use, the original extra heavy cast iron fittings made by a reputable manufacturer which have given excellent service with a total temperature of as high as 500 degrees F. These fittings have been in service some 5 years under superheated steam conditions without showing any apparent signs of weakness.

While speaking of steam piping, it may be added in additional favor of superheat (to quote) that "due to the absence of moisture, superheated steam offers less friction passing through pipes than saturated steam, therefore, the speed of travel can be higher and the piping, fittings and valves smaller. When piping is designed especially for superheated steam, the reduction in size will go far towards paying for the superheaters. Where it is turned into an existing system of piping, the radiation may be some greater than if the piping were of proper size, but the reduction in pressure would be less. The actual radiation from superheated steam, under similar conditions, is less than it is with saturated steam, because, even though the temperature is higher, its low conductivity makes it lose heat less rapidly. Besides, the pipes are not so wet and hence have less conductivity. Depending on the steam speed and the pipe protection, superheated steam is figured to lose one degree of superheat in from 6 to 10 ft. of travel."

Effect of Superheat on Compound Pumping Engine

Reverting again to the tests made on the compound pumping engine to determine the effect of superheat. The pumping engine when it was originally installed, 25 years ago, developed a duty of 118 million foot pounds per 1,000 lbs. of saturated steam, no superheat being used at this time. The pumping engines at this station were all bought on the bonus and forfeiture basis, which naturally led the contractor to make every effort toward obtaining the very highest duty possible. The Department, however, in running the duty tests with variable degrees of superheat, made no attempt whatever to increase the economy of the pumping unit before the test was run, by increasing the vacuum, repacking the plungers, renewing pump valves, inspecting valves and pistons, and so forth. In other words, the test was run on a pump running under every day plant conditions, and even with a superheat of only 28 degrees, which is the lowest we could obtain, the pump developed a duty of 132 million foot pounds per 1,000 lbs. of steam, which is a saving of 11.9 per cent. in steam consumption over that of the original duty test with saturated steam, where the duty obtained was 118 million foot pounds per 1,000 lbs. of steam. This is a very creditable showing for a pump that has been in service for 25 years.

As we previously mentioned we expected a better saving by the use of superheated steam on our compound low service pumping engines than on the high service triple expansion engines, for the reason that a compound pumping engine of the usual cylinder proportions is not as economical as a triple expansion pumping engine, due to a greater heat drop in each cylinder, causing a greater cylinder condensation, and as superheated steam specifically functions to prevent cylinder condensation, it follows that its greatest virtue will be manifested in the less economical engine.

Handling Lubrication

There seems to be, to the writer's knowledge, a prevailing impression in a great many water works plants, that the use of superheated steam with its consequent economies is offset by difficulties with lubrication. This contention is not borne out by the experience of our Department.

For a short period, a straight mineral oil with no tallow was used as cylinder oil with superheated steam, but was found to be unsatisfactory. It was found that the compounding with tallow was necessary.

In lubricating engines using superheated steam, the only parts which actually come into continuous contact with superheated steam are the inlet valves on the high pressure cylinder, for all other parts of the engine beyond this point, cylinder and piston, are at a mean temperature lower than the steam temperature entering, due to the fact that steam with even 100 degrees F. superheat becomes saturated by the time the piston travels to the point of cut-off in the high pressure cylinder. We found that our lubricating problems were, therefore, no more difficult with superheated steam than with saturated steam. Our cylinder oil possesses the following characteristics, to quote our specifications:

Cylinder Oil Characteristics

Cylinder oil shall be a compound oil of 2 per cent. pure acidless tallow oil, and 98 per cent. pure filtered mineral oil. It must be free from dirt, grit, lumps and specks; transparent amber in thin film; bright ruby through neck of 4-oz. bottle; translucent greenish by reflected light. It must satisfactorily pass the following tests:

Specific Gravity—26° to 28° Beaume at 60° F.
Flash Point—Must not flash below 540° F.
Burning Point—Must not burn below 600° F.
Viscosity—Must not be less than 130 Saybolt at 212° F.
Cold Test—Must flow readily at 50° F.
Water—Must not froth or bump when heated in flash cup.
Tarry and Suspended Matter—5 ccm of this oil shaken with 95 ccm of 88° petroleum ether in a glass stoppered graduate must show no precipitation of tarry and suspended matter.
Volatility—Heated for 2 hours at a temperature of 400° F. this oil must not show a loss of more than 5 per cent. by weight.
Saponification—When oil is treated with alcoholic potash it must show a presence of 2 per cent. tallow oil.
Quality Test—Heated slowly over an open flame until vapors appear above the oil surface. Maintained at this temperature for 15 minutes. Oil must remain perfectly clear and free from sediment, after standing for 24 hours.

Effect of Superheated Steam on Turbine Driven Centrifugal Pumps

We will now consider the comparisons of the performances of steam turbine driven centrifugal pumps, with and without the use of superheated steam.

Our turbine driven pumps are installed in the same station with the low service compound pumping engines previously referred to. Two of these are of the single stage centrifugal type, each of a nominal capacity of 35 million gallons of water a day. They were installed in the year 1913, and have been in active service ever since. The test duties of these pumps, at a head of 65 ft. was 100 million foot pounds per 1,000 lbs. of saturated steam.

A recent test run under the same pumping conditions, but with 124 degrees of superheat instead of saturated steam, showed a duty of 115 million foot pounds per 1,000 lbs. of steam, an increase in duty of 15 per cent. The physical condition of the pump may be said to have been the same as when the test was run on superheated steam as on the original test with saturated steam for the reason that the unit had just been overhauled; a new steam wheel was installed, the nozzles were rebored and new pump impeller wearing rings were installed.

On the same turbine driven centrifugal pump, comparative tests were made to determine the difference in duty, with the same superheat and vacuum, before and after the pump was overhauled as just described. The duty before overhauling was 93.5 million foot pounds per 1,000 lbs. of steam. The duty after overhauling was 106 million foot pounds per 1,000 lbs. of steam, showing a saving of 13.3 per cent., due entirely to overhauling.

It might be well to mention that the pumps at our low service station are subject to abnormal wear due to their pumping raw river water containing a great deal of sand in suspension.

In conclusion it is hoped that the results of our experiences herein mentioned will serve as a guide to water works engineers in general in their efforts to reduce their pumping station losses to the lowest possible minimum as a means of partly meeting the present increased costs of coal, labor and materials.

The foregoing paper by Mr. Day was presented at the 1920 annual convention of the American Water Works Association.

SEWAGE TREATMENT TO PROTECT WATER SUPPLIES

By Harry B. Hommon, Associate Sanitary Engineer, U. S. Public Health Service, Cincinnati, Ohio

It is common practice for a city to take its water from a river at the upstream side and discharge it below the city as sewage. This dual use of a water-course has been accepted and recognized by the courts as coming within the rights of the riparian proprietor but only in so far as the privileges claimed do not conflict with similar rights of others located on the same body of water.

It is not always an easy matter, however, to decide where the rights of one party end and the lawful privileges of another begin. In the past, and to a certain extent at the present time, courts have been called upon to decide controversies arising from the use of streams

Always an Asset

Never a Liability

IN addition to its permanent value U. S. Cast Iron Pipe possesses many other practical features—may be relaid after years of service in another location—has a definite salvage value of from 40 to 50 per cent of its original cost—high flow capacity, tightness, strength and resistance to electrolytic as well as corrosive action, and is impervious to rust. It is interesting to note that 95 per cent of all water mains laid in 1915, the last time statistics were compiled, were **Cast Iron.**

Write for further details.

UNITED STATES CAST IRON PIPE AND FOUNDRY CO.

GENERAL OFFICES: BURLINGTON, NEW JERSEY

SALES OFFICES:

Philadelphia—1421 Chestnut Street
New York—71 Broadway
Pittsburgh—Henry W Oliver Building
Minneapolis—Plymouth Building
Buffalo—957 East Ferry Street
Chicago—122 S. Michigan Boulevard
St. Louis—Security Building
Birmingham, Ala.—1002 Am. Trust Building
San Francisco—Monadnock Building
Cleveland—1150 East 26th Street
Dallas, Texas—Scollard Building

For quotations or estimates apply to nearest sales office.
For literature or special information apply to Publicity Department, Desk 6, Burlington, New Jersey.

as a means of disposing of sewage and other wastes. More recently many states passed laws to regulate stream pollution and the results have been so satisfactory that it is believed that within a few years all the states will have laws on their statute books which will permit active control over the purity of the water-courses in the country within the boundaries of the states.

Fundamental Principles Recognized by the Courts

One of the most important results that has come from the court decisions handed down, and the state laws that have been passed in relation to stream pollution, has been the treatment of sewage as a means of protecting water supplies. It may be of interest in this connection to quote the fundamental principles given by Montgomery and Phelps, which the courts have recognized as the basis for their decisions.

> The basic rule in common law has been stated to be that each riparian proprietor has the right to have the stream come down to him with its quality unimpaired and with its quantity undiminished.
>
> But expressions like the above are extreme statements of the rule and cannot be accepted literally.
>
> That is to say, each riparian proprietor is interested on the one hand, in having the water come down to him in its natural state and in its full volume. On the other hand, he is interested in making the largest use of the stream which his convenience or interest may dictate; and since almost any use of the stream has some tendency either to diminish the volume or lessen its purity, or both, it follows that a rule which would preclude each riparian owner from polluting the stream at all or from diminishing its volume at all would defeat its own purpose; and this has been recognized by the courts.

Quoting further from the report referred to above, it is shown that municipalities have no further rights than individuals.

> By the great weight of authority, municipalities have not greater rights than individuals to pollute water-courses and must respond in damages for any injury caused to a lower riparian proprietor and may be enjoined continuing the pollution.

It is thus seen that the courts have recognized the right of an individual, corporation, or city to use a water-course as a means of carrying off its sewage but only to such an extent that riparian proprietors lower down on the same stream will not be deprived of the natural rights accruing from their vested property rights.

If the water in the rivers and lakes of the thickly settled portions of the country were used only for such purposes as the courts and state laws have held as coming within the riparian proprietory rights, it is doubtful whether these sources would furnish a water satisfactory for domestic purposes without some degree of treatment. Even water supplies obtained from protected watersheds located in the hills, mountains, or on the headwaters of streams are often sterilized to guard against accidental pollution.

In considering, therefore, the protection of water supplies by sewage treatment the important problem is not so much as to whether any given water requires purification but rather what effect the presence of sewage in unusual amounts will have on the process of treatment and the character of the water produced. The term sewage is used in the broader sense to include all liquid wastes discharged either from a city's sewers or through outlets from manufacturing plants outside the city limits.

Chief Factors to Be Considered

Using the broader meaning of the word sewage, it becomes apparent at once that a city must consider many factors when deciding whether any given stream that contains a large amount of untreated liquid wastes from other communities is a suitable source for a domestic water supply. These factors will be discussed from the standpoint of the relation they bear to the operation of a purification plant and the quality of water produced.

(1.) The bacterial content of the water. A stream containing comparatively fresh sewage in large amounts will have large numbrs of pathogenic organisms and the potential danger of using such a water, even though filtered and sterilized, may be justification for rejecting the supply or cause for requiring cities or towns upstream to treat their sewage.

(2.) Color. River or lake waters may contain sewage and colored industrial waste to such an extent that the ordinary purification processes will not remove the color. Dye wastes, tannery, and sulphite wastes from paper manufacturing plants are often discharged into streams in large volumes and the color imparted to the water persists for long distances.

(3.) Alkalinity. The normal hardness of river water may be so increased by the presence of sewage and industrial wastes that softening processes will be required; or spent acids may be discharged into a river in sufficient amounts to reduce the alkalinity so that, where coagulation is necessary, an additional amount of chemicals will have to be added.

(4.) Odors and Tastes. River water may have pronounced odors and tastes due to the presence of some industrial wastes. Those from gas manufacturing and oil refineries are the most common.

(5.) Temperature. Industrial establishments located on small streams may use a large part of the stream flow for cooling and other industrial purposes and thereby raise the temperature of the water of the entire stream. The writer is familiar with one case where the water at the intake of a filtration plant has a temperature of 137 degrees Fahrenheit in the summer time.

(6.) The Aesthetic Consideration. Rivers carrying floating particles common to sewage, do not add to the attractiveness of a water as a source for drinking purposes. No matter how efficient filtration may be, public sentiment is against using water from sources in which direct evidences of sewage pollution can be seen and it is not necessary that such evidence be in the immediate neighborhood of the water intake.

Local Conditions

The extent that the influences noted above will affect any particular water supply will depend on local conditions. For example, the sewage and industrial wastes from the Pittsburg district on the Upper Ohio river do

not interfere with the use of the river water at Cincinnati for domestic purposes, and the presence of these wastes does not place an undue burden on the filtration plant. In this particular case the distance between the two cities on the Ohio River, and the dilution, are sufficient to permit self-purification to take place.

There are, however, many cities and towns located on streams that would furnish suitable water supplies for domestic purposes if it were not for the fact that the time of flow and dilution of sewage from neighboring communities above are not sufficient for self-purification to take place. In such cases, and there are many of them, sewage treatment should be required, the extent, however, depending upon local conditions. Where the dilution is high but the distance between the point of sewage discharge and water intake is comparatively short, fine screens or some form of tank treatment, followed by sterilization may be sufficient. If the dilution and time of flow of sewage discharged into a stream from one city is insufficient to permit self-purification to take place before reaching the water intake of another, complete oxidation in a sewage treatment plant is necessary and in some cases sterilization will be required in addition. Each problem of sewage disposal is, therefore, a special study in itself and before plans are prepared, a thorough examination should be made to learn what the local requirements are and what design of sewage treatment plant will meet them most satisfactorily.

Standards of Treatment

In water treatment plants it has been possible to adopt standards of purification that are practical and they are being maintained throughout the country. In sewage treatment, however, the purpose is not to maintain a standard which will apply to all plants but rather so to modify the sewage that the natural purifying power of the water in the streams will complete the oxidation of the organic matter remaining in the effluent of the disposal plant. In other words, the effluent from water purification plants must conform to well-defined, uniform standards of quality while the effluent from sewage treatment plants may be of varying quality depending on the power of the receiving body of diluting water to bring the purification to the required standard.

The science of sewage treatment has progressed to the point where special processes can be recommended for purifying sewage to any degree required. The type of plant best suited for any given city should be determined, however, by a competent sanitary engineer. Enough money should be available for constructing the plant recommended, and provision should be made for the supervision of the operation. The failure of a large number of sewage disposal plants in operation today to produce satisfactory effluents is due in a very large measure, either to the fact that enough funds were not available to build the treatment plant as large as was recommended by the engineer who designed it, or it has been outgrown, or there is a lack of control over the operation. The mistakes that have been made are not inherent in the principle involved, so that cities wishing to purify their sewage for the protection of water supplies can install and operate properly designed treatment plants with confidence that they will produce the results expected from them.

The question of deciding when one city is discharging more sewage into a stream than its self-purifying powers can take care of before reaching the water intake of another city lower down on the same stream is not always easy to determine. In extreme cases there will be found, on the one hand, situations where the water at the intake of a city will contain direct evidences of sewage pollution such as floating material common to sewage, and on the other hand, places where the only evidence of sewage that can be found in the water will be the increased numbers of bacteria and an excess of organic matter. Only a very superficial examination is necessary in the first case to decide whether sewage treatment is necessary for the protection of a water supply, but at the other extreme a very careful survey of the entire situation must be made, including chemical and bacteriological examinations of the water that extend over considerable periods of time.

Expert Testimony

Formerly when the courts were called upon to decide the relative merits of controversies arising from questions of stream pollution the evidence was, naturally, more or less biased by the purpose for which it was to be used. Even where technical evidence was given there was a tendency to omit data which might not advance the interests of clients. From the very fact that the parties to such a suit were interested primarily in winning their case and due to the fact that judges and jurymen could not be expected to be familiar with the science of sewage treatment, water purification, and the factors entering into stream pollution, it was not always possible to settle cases on their true merits. There never was, however, any doubt as to the fundamental law regarding the riparian proprietory rights, discussed earlier in this paper, but the evidence was lacking in some cases upon which proper interpretation could be made.

State Supervision

A few years ago it became apparent that the courts were not the proper places to decide whether a stream of water had become so badly polluted with sewage that the water was unfit for domestic purposes. It was felt that the greatest use possible should be made of our water-courses in carrying off the liquid wastes from cities and that the authority for deciding when a stream had reached its capacity for carrying sewage should be vested in the state. Accordingly, many states enacted laws for controlling stream pollution and authority for their enforcement has been given to the various state boards of health. For the purpose of carrying out the purpose and intent of these laws, sanitary engineering departments have been developed. These include a chief engineer and assistants, chemists, bacteriologists and laboratory facilities.

It is possible for any state, through such an organization as referred to above, to keep watch over the streams within its boundaries and to require that they be maintained in a sanitary condition. When controversies do arise over questions of stream pollution the states should have the means of collecting the important data by experts and presenting the information in an unbiased manner. However, stream pollution cases between individuals and cities ought never to reach the courts in states

Engineers' and Contractors' Directory

JOHN W. ALVORD :: CHAS. B. BURDICK
Consulting Engineers
Water Supply Sewerage Water Works
HARTFORD BUILDING, CHICAGO, ILLINOIS.

WALTER H. FLOOD & CO.
PAVING LABORATORIES
Plant and Street Inspection. Testing and Inspection of Materials.
Offices: 22 Quincy St. Laboratories: 742 E. 39th St.
CHICAGO, ILL.

Wm. Artingstall
Civil Engineer
WATER SUPPLY SEWERS SEWAGE DISPOSAL
Old Colony Building Chicago

Farley Gannett Theodore E. Seelye Samuel W. Fleming, Jr.
GANNETT, SEELYE & FLEMING
ENGINEERS
204 Locust St. Harrisburg, Penna. | 10th Floor Ariel Bldg. Erie, Penna. | Randolph Bldg. Memphis, Tenn.
All branches of Municipal Engineering, including City Planning, Paving, Water Works, Sewers, Sewage Disposal, Preliminary Reports and Estimates of Cost for Bond Issues. Valuation of Public Utilities for Rate Making and Purchase. Water and Sewage Analysis

CHAS. BROSSMAN
CONSULTING ENGINEER
Water Supply. Sewerage and Disposal. Lighting Plants—Supervision of Construction and Reduction in Operating Cost. Appraisals—Expert Testimony.
Merchants Bank Building INDIANAPOLIS, IND.

SAMUEL A. GREELY
39 W. Adams Street CHICAGO, ILL.
Hydraulic and Sanitary Engineer
Water Supply and Purification. Treatment of Sewage, Garbage and Industrial Waste. Construction, Operation and Valuation.

BURD & GIFFELS
CIVIL ENGINEERS
POWER DEVELOPMENTS WATER SUPPLY
SEWERAGE
KELSEY BUILDING GRAND RAPIDS, MICH.

J. W. HOWARD
CONSULTING ENGINEER
ROADS AND PAVEMENTS
Laboratory Analyses and Tests. Specifications improved
Expert in Valuation and Litigation. 31 years' experience
1 Broadway NEW YORK CITY

CHICAGO PAVING LABORATORY
L. KIRSCHBRAUN H. W. SKIDMORE
CONSULTING and INSPECTING ENGINEERS
PAVEMENTS and PAVING MATERIALS
Consultation, Design, Specifications, Reports, Testing, Inspection and Research
160 North Wells Street CHICAGO

SAM. L. JONES, Consulting Engineer
PAVEMENTS and ROADS
Specifications, Estimates and Cost Systems
807 Second Nat'l Bank Bldg. CINCINNATI, OHIO

CITY-WASTES DISPOSAL CO.
(Organized from Staff of Col. Geo. E. Waring, Jr.)
Consulting Engineers. Specialists in Drainage, Sewerage and Sewage Disposal. Preliminary Investigations and Estimates, Surveys, Plans and Supervision. Sanitary Examinations and Reports.
45 Seventh Avenue. NEW YORK.

W. G. KIRCHOFFER
Sanitary and Hydraulic Engineer
Water Supplies Water Purification Sewerage
Sewage Disposal Land Drainage
22 N. Carroll St. MADISON, WIS.

DOW & SMITH
CHEMICAL ENGINEERS
CONSULTING PAVING ENGINEERS
A. W. DOW, Ph. B. Mem. Amer. Inst. Ch. Engrs. | F. P. SMITH, Ph. B. Mem. Amer. Soc. Civil Engrs.
Asphalt, Bitumens, Paving, Hydraulic Cement, Engineering Materials.
131-3 E. 23rd Street NEW YORK CITY

ALEXANDER POTTER, C. E.
HYDRAULIC ENGINEER AND SANITARY EXPERT
50 Church St., New York City.
Sewerage and Sewage Disposal, Water Supply and Purification, Water and Electric Power.
Valuations of Existing Plants where MUNICIPAL OWNERSHIP is Contemplated — Expert Testimony — Plans and Estimates.

ASTRID S. ROSING, Inc.
Sewer Pipe—Drain Tile—Steam and Electric Conduits—Building Tile—Fire Brick
Harris Trust Company CHICAGO, ILL.

SULLIVAN, LONG & HAGERTY
GENERAL CONTRACTORS
Builders of Sewer Systems and Water Works Plants.
Home Office, BESSEMER, ALA.

W. S. SHIELDS
CONSULTING ENGINEER
Municipal Improvements. Water Supplies and Water Works Systems. Sewers and Sewage Disposal. Pavements and Roads.
Hartford Building. CHICAGO, ILL.

Testing, Consultation, Bitumens, Paving.
Inspection, Specifications, Asphalts, Road Oils.
ISAAC VAN TRUMP
ENGINEERING CHEMIST
2337 South Paulina Street. CHICAGO, ILL.

SEWER PIPE — FIRE BRICK
Flue Linings — Wall Coping — Steam Line Conduit — Sewage Disposal Tanks — Fire Clay Meter Boxes
IN STRAIGHT OR MIXED CARS. Manufactured of OHIO RIVER FIRE CLAY.
CANNELTON SEWER PIPE CO., Cannelton, Ind.

New Automatic Cement Tester
Grand Prize Panama-Pacific International Exposition, 1915.
Manufacturers of Cement, Concrete, Brick and Road Material Testing Machines and All Auxiliary Laboratory Apparatus
Tinius Olsen Testing Machine Co.
500 North Twelfth Street PHILADELPHIA, PA.

having a well-organized sanitary engineering department, for the reason that the states should require that corrective measures be applied before conditions reach the point where a law-suit becomes necessary.

The state department of health of every state should have a competent sanitary engineering department with sufficient personnel and equipment to look after the sanitary conditions of all the water-courses within the state. The department will be almost useless, however, if the necessary authority is not given to require that its recommendations be put into effect. The protection of water supplies by enforcement of sewage treatment is a function of the state acting through its department of health, and the extent to which waterways sanitation is enforced will depend upon the laws passed to require sewage treatment, and the personnel and equipment provided to carry out the work.

Interstate Streams

The states have jurisdiction over the rivers and lakes within their boundaries, but there is no authority at present to require cities located on interstate streams to treat their sewage for the protection of water supplies taken from these streams by cities in other states. The industries along our main waterways are sure to increase in size and number and with them the population will grow apace. The time must come, therefore, when the streams can no longer be utilized, as they are today, for carrying off the raw sewage and wastes from large and thickly settled communities without seriously affecting the use of the water for domestic purposes. The National Government alone has the authority to control the pollution of interstate streams, and it would appear to be in the interest of economy as well as the best interests of future generations for the government to guard these streams against excessive pollution that may be difficult and expensive to remove if allowed to progress too far. If laws are passed by the government for the control of sanitation in the interstate streams, they should be closely correlated with the laws of the various states relating to the intrastate streams.

The United States Public Health Service, under authority of an Act of Congress passed in August, 1912, has been making a study of the pollution of the interstate rivers, but this law provided only for an investigation of conditions as they exist today. It is believed, however, that the data obtained will eventually be used as a basis for framing the necessary laws for preserving the interstate rivers of our country as a safe source of water supplies for the large cities located on them.

Acknowledgment

This paper by Mr. Hommon was presented before the 1920 annual convention of the Illinois Section of the American Water Works Association.

STEWART SEWER CLEANING MACHINE

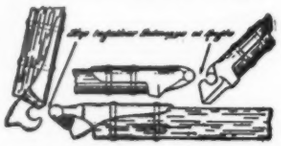
Water Cleaning System if you wish it, or Drag Bucket type.

Also have TURBINE SEWER CLEANING MACHINE at Low Price.

WE WILL PAY FREIGHT AND CHARGE TO BILL.

We Ship Rods for Trial—who else will do this?

We also make a Rod that will float. Also Rods with wheels for conduit work.



SEWER AND CONDUIT RODS

No Deep Shoulder Cut for Couplings—Rods retain full size and strength

Investigate our JUMBO ROD

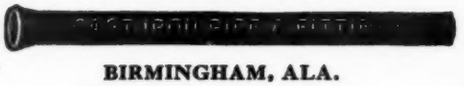
W. H. STEWART

1614 Locust Street - - ST. LOUIS, MO.
129 George Street - - - BOSTON, MASS.

CANADA FACTORY, WALKERVILLE, ONT.
THEREFORE NO DUTY FOR PURCHASER TO PAY
PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.

American Cast Iron Pipe Company

MANUFACTURERS OF



BIRMINGHAM, ALA.

SALES OFFICES:

Birmingham, Ala.	Box 908.
Columbus, Ohio	607 New Hayden Building.
Minneapolis, Minn.	712 Plymouth Building.
New York City	No. 1 Broadway.
Chicago, Ill.	512 First National Bank Building.
Dallas, Texas	1217 Praetorian Building.
Kansas City, Mo.	716 Scarritt Building.
San Francisco, Cal.	711 Balboa Building.
Los Angeles, Cal.	339 Citizens National Bank Building.

DIRECT OXIDATION PROCESS

Apparatus for carrying out this Process for Sewage and Water Treatment supplied upon Engineers' specifications.

Direct Oxidation Process Corporation
15th and Lehigh Ave. Philadelphia, Pa.

WM. E. DEE COMPANY

30 North La Salle Street, CHICAGO, ILL.

Patent Numbers
965163-1177850

WE MANUFACTURE

D & D Safety Cover

GUARANTEED NOT TO RATTLE OR DISH

Full Line of MANHOLE and CATCH BASIN COVERS of all Kinds.

WRITE FOR OUR PRICES

ACME

Manholes, Catch Basins, Inlet Basins, Park Basins (All Styles)

REGULAR AND SPECIAL GRATES OR STRAINERS FOR SEWER PIPE.

BUILDING COLUMNS OF ALL DESCRIPTIONS.

SEND US YOUR SPECIFICATIONS

MADISON FOUNDRY CO.

927 Addison Road, CLEVELAND, OHIO.

BEST EXTENSIBLE TRENCHING BRACE MADE

KALAMAZOO F'DRY & MACHINE CO. MICHIGAN

594 EAST MAIN STREET.

SLUICE GATES

Shear, Flap and Butterfly Valves

FLEXIBLE JOINTS

COLDWELL-WILCOX CO.

South Water Street NEWBURGH, N. Y.

CHLORIDE OF LIME

FOR PURIFYING WATER

PENNSYLVANIA SALT MANUFACTURING CO.

115 Chestnut Street, PHILADELPHIA, PA.

This Water Works Section is a Regular Feature of

Municipal and County Engineering

Published Monthly at
538 S. Clark St. Chicago, Ill.

Subscription price for the Full Number, $2.00 per year.

CONSTRUCTION NEWS AND EQUIPMENT

CONSTRUCTION EQUIPMENT EMPLOYED IN BUILDING REINFORCED CONCRETE PAVEMENT ON JEFFERSON HIGHWAY, RICE COUNTY, MINN.

By P. C. Brown, Assistant Engineer, Rice County, Faribault, Minn.

The paving on the Jefferson Highway, which is being done by Siems, Helmers & Schaffner for Rice County, Minn., extends between the cities of Northfield and Faribault. The work is known as Minnesota Federal Aid Project No. 64, and is 12.9 miles in length. The paving consists of reinforced concrete, mixed in the proportions 1-2-4, with a thickness of 6½ to 7½ ins. This is the Minnesota Highway Department's standard for highway paving. There is to be an earth or gravel shoulder of 4 ft. width, built up flush with the edges of the paving. In laying the grade a maximum of 5% was used. In some places on the project it has been difficult to keep the wet concrete from creeping so it would not be advisable to use any steeper grade than this.

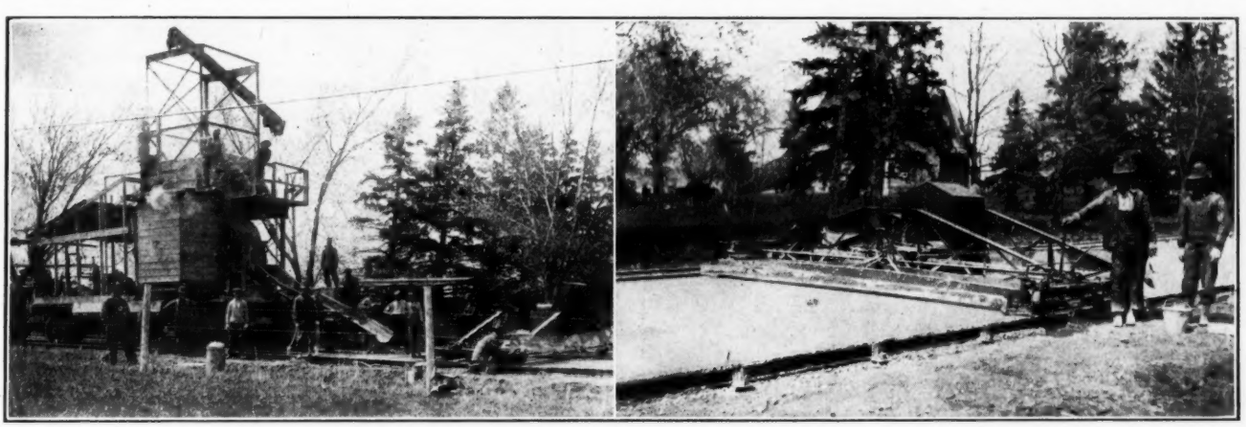
Grading Equipment

The grading equipment being used on the project consists of two elevating graders. One 8 ft. blade grader, 4 fresnos and 14½ yd. dump wagons. Nearly all of the heavy excavation is being done by the elevating graders. Horses are used on all of the grading equipment. A tractor was tried on one of the elevating graders, but its use was discontinued. No roller is being used on the fills, but its use would be advisable where the paving is to be done within two or three months after the grading has been completed. This is especially true on relocations, where there is no traffic between the time of grading and paving. The total amount of excavation on the entire project is about 102,000 cu. yds., and, with the equipment listed above, the largest amount of earth moved during any one month was during the month of June, 1920, when the amount of excavation was 18,000 cu. yds.

The final finish is given the subgrade just before the concrete is placed. This work is done largely by hand. A slip scraper is used when holes or depressions are found in the grade. A Lakewood subgrade machine has been ordered, but has not as yet been used.

Handling the Aggregate

The aggregate used in the paving consists of Randolph, Minn., sand and crushed rock from a quarry located about two miles from Faribault and operated by Siems, Helmers & Schaffner. This material is shipped in gondola cars. It is unloaded at two concentration points along the line of paving. The unloading is done by a clam shell bucket, which deposits the aggregate in stock piles. This method of handling the material has proven this method it is possible to keep a large reserve supply on hand. There has been some difficulty in getting to be very satisfactory, as there is little waste, and with enough freight cars to handle the transportation, but up to the present time it has not been necessary to shut down on account of lack of supplies. At first bulk cement was used, but this proved to be too difficult to handle and caused quite a lot of waste.



VIEW OF LAKEWOOD CONCRETE MIXING AND FINISHING EQUIPMENT EMPLOYED ON JEFFERSON HIGHWAY CONSTRUCTION BETWEEN NORTHFIELD AND FARIBAULT, MINN.

Industrial Railway.

The material is transported from these concentration points to the mixer by means of an industrial railway. Two gasoline and two steam locomotives are used on the project. The trains consist of 5 to 7 cars, each car carrying two boxes. The boxes have a capacity of ¾ cu. yd., or one batch. The gasoline locomotives are used to take the material out on the project, while the steam locomotives are used at the loading point to handle the cars as they are being filled.

These industrial trains are loaded at the concentration

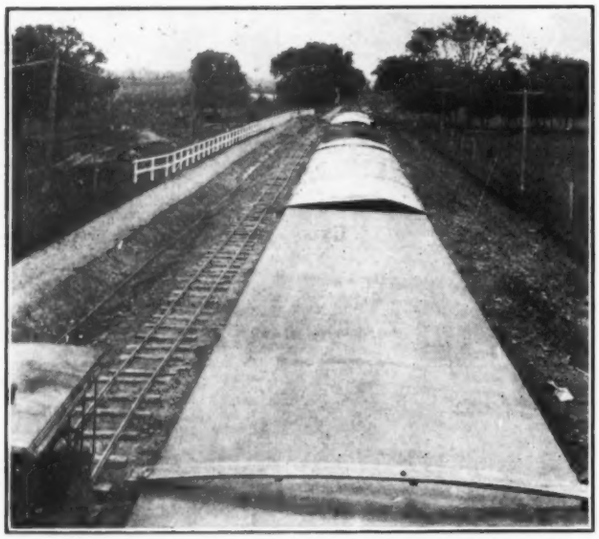
Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, Chicago, Ill., September, 1920.

points with the proper proportions of aggregate and cement in each batch box. The same clam shell bucket, which unloads the gondola cars, takes the material from the stock piles and places it in large hoppers. The boxes are run under these hoppers and filled by gravity. The rock is placed in the bottom of the car, the cement next, and the sand on top. These trains are run up to the mixer and the boxes are lifted to the top of the feeding hopper by means of a steam hoist. The boxes are equipped with dump bottoms and are dumped directly into the mixer as soon as the preceding batches have been run out.

Mixing, Placing and Finishing Concrete.

The mixer used on the project is a Lakewood ¾-yd. machine. It is placed on the subgrade just ahead of the concreting. The mixer is moved by means of a 35 h. p. Minneapolis steam tractor. This tractor furnishes steam to operate the mixer and the hoist lifting the batch boxes.

The concrete is mixed for one minute and then run on to the subgrade by means of a chute. The finishing is done by means of a Lakewood finishing machine. This machine gives fairly good satisfaction, but with one exception, which is worth while noting. When the first three miles were thrown open to traffic it was found that the surface of the pavement was rough in places, especially on the slopes. It seemed that when the finishing machine was run over the surface the tamping caused the wet concrete to bulge up somewhat in the rear of the machine. At first it was thought that this was due to the fact that the forms were not placed on the proper supports, but on closer examination it was seen that it could not have been caused in this way. As soon as this roughness was noticed methods were used to prevent it from occurring in any more of the pavement which was to be placed. The forms were placed on better foundations and two finishing machines were used. Up to the present date none that has been finished this way has been thrown open to traffic.



METHOD OF CURING CONCRETE ON JEFFERSON HIGHWAY, RICE COUNTY, MINN.

After Finishing, Pavement Is Covered with Canvas Stretched on Bows Strung with Wire. After Initial Set Canvas Is Removed and Earth Covering Is Sprinkled On. This Earth Is Kept Moist for Two Weeks and Then Removed. In Another Week Pavement Is Opened for Traffic.

A force of 95 men is used to handle the unloading apparatus, the industrial railway and the mixing plant. With this force, during the month of May, 1920, 15,199 sq. yds. were placed.

Curing

As soon as the finishing machine has been run over the surface of the concrete for the last time it is covered with a canvas cover made of canvas stretched on bows of 6-in. boards, strung with wire. When the concrete has taken its initial set the canvas is removed and a covering of earth is sprinkled over the surface. This earth is kept moist for a period of two weeks, after which it is removed and in another week the pavement is ready for traffic.

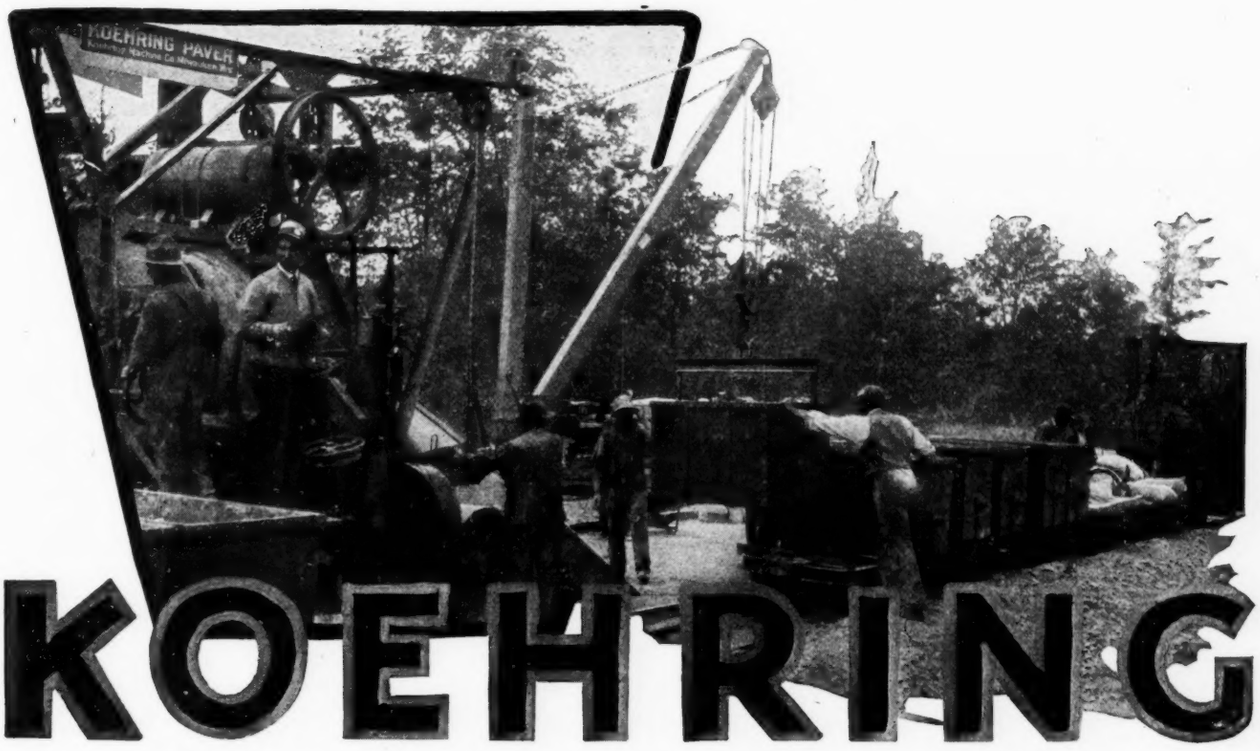
NEW METHOD OF HANDLING CONCRETE MATERIAL ON MINNEAPOLIS PAVING JOB

By Ellis R. Dutton, Assistant City Engineer, City Hall, Minneapolis, Minn.

In these times of the high cost of labor, it is very essential to take advantage of labor saving machinery and to introduce it wherever that can be done. In paving work the largest percentage of labor is in the construction of concrete.

Not only has the price of labor greatly increased but it is also true that the efficiency has decreased, thereby adding more to the high cost. There have been various devices, designed to reduce the labor necessary in concrete work, which have been more or less successful—but most of them have not been sufficiently elastic to take care of contingencies that arise in all work. If everything was placed just so and all went well they were all right. In our old method, we planked the sub-grade and hauled the materials on the plank and used wheelbarrows to get it into the mixer. This was all right when the prices of lumber and labor were cheap and before the use of trucks for delivery, but at the present price of lumber and the destruction by truck, it is out of the question.

With the introduction and perfection of the bucket loaders, the shoveling of the aggregate was done away with but we still had the problem of getting the material from the loader to the mixer. It was only recently that a truck tractor was introduced, having a dumping body, which would hold a cubic yard of material and which when used in connection with the bucket loader, would seem to solve the problem. This combination is flexible, enabling one to haul the material 25 ft., or a block or two blocks or even more, the only requirement being to use sufficient trucks to keep the mixer going. In the ordinary way, using shovels and wheelbarrows and using two bag batches of 1-3-6 mixture, it would require about 16 men for the coarse aggregate. In using the loader tractor combination it would require 3 men for the short haul and 1 additional for each tractor, making for a block haul 6 men, giving a saving of 10 to 13 men, less the cost of the upkeep and fuel for the loader tractors. The pictures here show where the equipment was used on a street with a car line. In this case the coarse aggregate was dumped on the sub-grade from the car tracks and therefore it only required one truck tractor to keep the mixer going. The sand was dumped on the opposite



KOEHRING

Speedy Operation Plus Heavy Duty Construction

A BIGGER day's yardage from Koehring pavers because of mechanical high speed operation and automatic actions which make it possible for operators to **maintain** top capacity operation every minute of the day.

—because of Koehring heavy duty construction day-long, month-after-month top capacity operation is not penalized by breakdowns and delays. Koehring heavy duty construction is the surest profit-insurance, extra yardage factor you can put on the job.

Write for catalog—Also Mixer Loader catalog—

Koehring Paver Sizes in Cubic Feet Mixed Concrete

Four Sizes

Four sizes in the Koehring line enables you to fit the mixer to your work. 10, 14, 21 and 28 cubic feet mixed concrete. Standard wet batch rating. Boom and bucket and spout distribution, steam and gasoline. Loading derrick, caterpillar traction.

Construction Mixer sizes 4, 7, 10, 14, 21, 28 cubic feet mixed concrete.

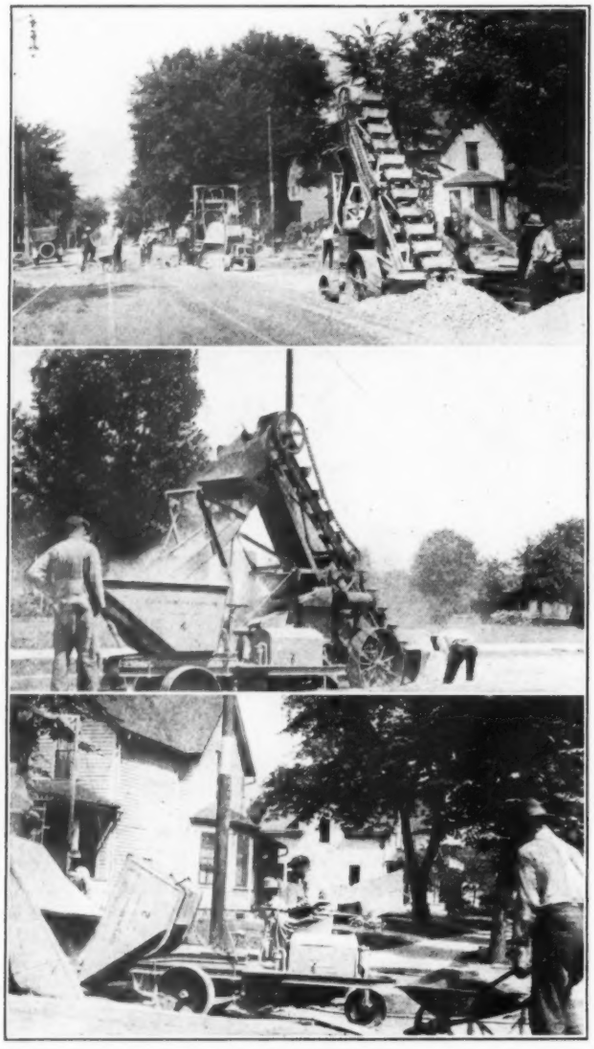
Koehring Machine Company

Milwaukee Wisconsin

Sales and service offices in all principal cities.

side of the street near the mixer and only required three men, with wheelbarrows, to place it in the mixer and making it about as cheap to use wheelbarrows.

There have been other methods suggested for use with the truck tractor, one being the use of portable



VIEWS OF LABOR SAVING EQUIPMENT USED ON PAVING WORK IN MINNEAPOLIS, MINN.

Top: General view of paving operations on East 25th St., July, 1920. Center: Loading Clark Tructractor with Barber-Greene Loader. Bottom: Dumping Tructractor into mixer loading skip.

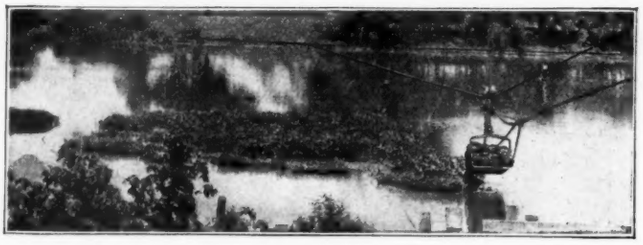
bins from which the tractors were to be loaded. These bins were loaded by a clam shell. Still another system was using a stationary mixer and hauling the mixed concrete to place on the street. In any of these methods, there is considerable saving of labor, thereby reducing the high cost of construction.

LARGEST MIXERS BACK IN SERVICE AFTER 60-FT. FALL

Recently, a fire at Wilson Dam, part of the Muscle Shoals project under Government construction, destroyed the tressle work at the cement shed. Two very large Smith tilting mixers, the largest in the world, capacity 4 cu. yds., fell approximately 60 ft. from their mounting on this tressle work. At first it was thought it would be necessary to replace the mixers entirely, but after careful examination it was found that proper repairs would return them to good working order. In spite of the terrific heat to which these machines were subjected in addition to a fall of 60 ft., practically no castings were broken. All the gears except the bevel gears survived the shock perfectly. Just three teeth in the main gear ring were smashed.

These mixers have both been in Government service for several years. Besides these two which were made for the Government, four others of this size were made for the Hardaway Construction Company several years ago, by The T. L. Smith Company, General Sales Offices,

MATERIAL-HANDLING SIMPLIFIED



THERE is a growing appreciation among engineers and contractors of the fact that the dragline cableway excavator method, so universally employed by commercial gravel-handling plants, can be utilized for other work involving excavating and moving materials over distances of from 100 to 800 feet or more.

The ability of the Sauerman Dragline Cableway Excavator to dig from either above or below water, and to elevate and convey materials from pit to plant without the help of auxiliary machinery, is the reason for its popularity among sand and gravel producers. This same ability makes our type of equipment correspondingly economical and efficient for a wide variety of other material-handling operations, and it is now being successfully used for cleaning reservoirs, building levees, rehandling coal, deepening rivers, reclaiming material from stock piles, loading ballast, etc., etc.

For further information send for our catalog, or lay the details of your problem before us and we will submit our recommendations on equipment.

SAUERMAN BROS., 1142 Monadnock Bldg., Chicago

SAUERMAN DRAGLINE CABLEWAY EXCAVATORS

THE SCOOP CONVEYOR

OVER 2000 USERS

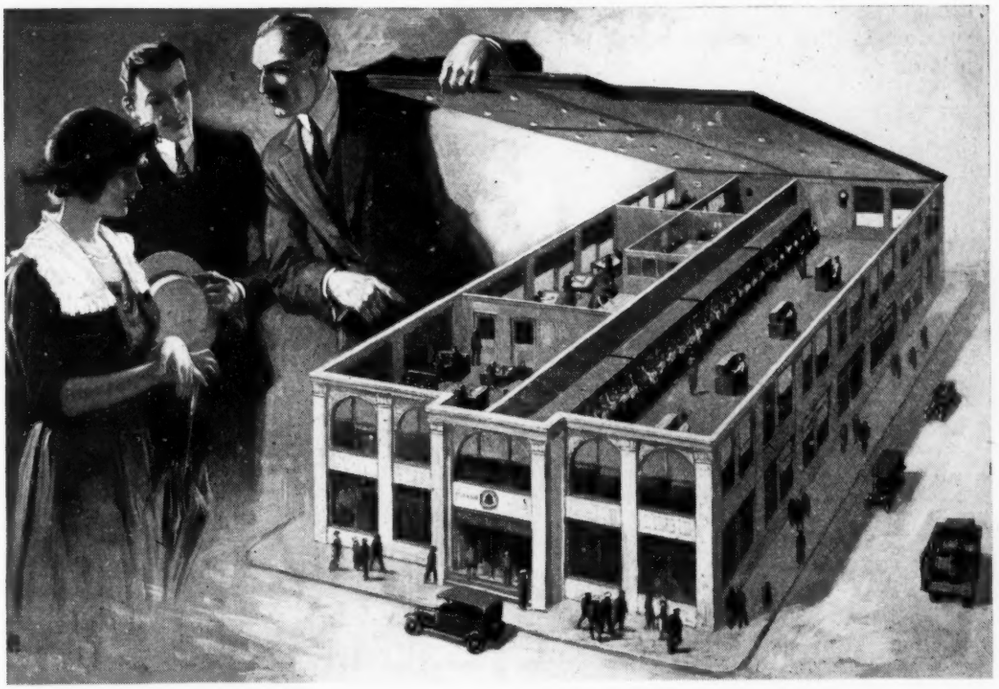
FOR STORING AND RECLAIMING LOADING AND UNLOADING CARS, TRUCKS AND WAGONS

DOES THE WORK OF FROM 6 TO 12 MEN

AND KEEPS EQUIPMENT MOVING

WRITE FOR LITERATURE

PORTABLE MACHINERY CO., PASSAIC N.J.



The Public Confidence

An important part of the management of the Bell System is to keep the public informed concerning all matters relating to the telephone.

We consider this an essential part of our stewardship in the operation of this public utility. It is due not only the 130,000 shareholders, but it is due the whole citizenship of the country.

We have told you of new inventions to improve service, of the growth of service, of problems involved in securing materials, employing and training workers, of financing new developments, and of rates necessary to maintain service.

You have been taken into our confidence as to what we are doing, how we do it, why we do it. You have been told of our efforts to meet unusual conditions; of how we have bent every energy to provide service in the face of storms, floods, fires.

It is an enormous task today to provide adequate service in the face of shortage of workers, raw materials, manufacturing production and transportation.

Nevertheless the service of the Bell System has been improved and extended this year. Over 350,000 new stations have been put into operation. And the loyal workers of the Bell System are establishing new records for efficiency and will establish new records for service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Chicago, Ill. They are the only mixers of this size ever built.

Each mixer weighs about 48,000 lbs. and has a capacity of 112 cu. ft. of mixed material, or 168 cu. ft. of loose, unmixed material. They are mounted on steel skids and each is equipped with gated batch hopper and frame, power tilting device and friction clutch pulley. The remarkable feature in their operation is that the entire mixed batch is discharged at one time by automatic

VIEW OF SMITH 4 YD. MIXERS AFTER 60 FT. FALL.

tilting of the entire drum, which revolves as it discharges. It is the same principle as dumping a bucket up-side down to empty it. This tilting principle as applied to mixers of this size gains enough time in discharging to enable the same sized crew to pour about 150 to 200 cu. yds. more per day than any type of non-tilting mixer could possibly pour.

LAUSON SPECIAL ROAD TRACTOR

Tractors are now playing a conspicuous part in road construction work. The ability of tractors to stand up under hard work without tiring or easing up makes them preferable to horses and mules.

Many manufacturers are building tractors especially designed for road work. The accompanying illustration

LAUSON KEROSENE TRACTOR ON ROAD CONSTRUCTION WORK, NEAR KANSAS CITY, MO.

shows the Lauson Full Jewel Kerosene Tractor on construction work near Kansas City, Mo.

This machine has heavy cast rear drive wheels, which give the necessary traction and prevent slippage on loose dirt roads, such as shown in the illustration. All gears are enclosed and run in a bath of oil. They are well protected from dust and dirt.

PERSONAL ITEMS

Mr. W. G. Thompson, until recently State Highway Engineer of New Jersey, is now associated with the Lakewood Engineering Co., with headquarters at 141 Centre Street, New York City. Mr. Thompson's first engineering experience was with Charles A. Nichols, a civil engineer of New Haven, Conn., on general surveys and engineering work covering water works, and street railway location and construction. In 1904 Mr. Thompson was with the United States Engineering Department as inspector of dredging and break-water work on Long Island Sound. From February, 1905, until March, 1910, he was a member of the Engineering Department of the Panama Canal, engaged in general survey and construction work, including topographical and railroad surveys, railroad and shop building construction. From May, 1910, until June, 1911, Mr. Thompson was employed as a draftsman in the Chief Engineer's office of the Oregon & Washington Railroad in Seattle, engaged principally on passenger terminal and freight classification yard layout. From June, 1911, to June, 1916, he was employed as Supervisor and Superintendent of Construction on the

W. G. THOMPSON

locks and terminal facilities of the Panama Canal. His work included the construction of reinforced concrete wharves, foundations, and of shop buildings, as well as the general construction of terminal facilities. During this time Mr. Thompson was in full charge of the construction of the Cristobal Coaling Plant, at the Atlantic entrance to the Panama Canal. From November, 1916, until April, 1917, Mr. Thompson was employed by the Raymond Concrete Pile Company of New York as superintendent on the construction of the Sun shipyard at Chester, Pa., and later as superintendent of construction for the Raymond Company at the Bethlehem Steel Plant

Asphalt Contractors:

Save and **Make** Money by Using

The Improved Merriman Asphalt Plant

Everybody knows that possession of this plant insures good work and this helps you get the contracts. You will save money because the **Merriman** handels more asphaltic material than any other plant and at less cost.

This plant positively does away with burned or coked asphalt or clogged pipes.

Trouble in the pipe line between the melting tanks and weigh bucket is eliminated.

A. C. lines and fittings are steam-jacketed.

This plant has numerous fine records to its credit. It has been used for years by the leading asphalt paving contractors. Investigate the performance records of the Merriman.

"The Merriman" is a One-Car Railroad Plant, 55 feet over all; built on special girder-type side sills. Large drum and kettle capacity (a day's run in each kettle; independent power units (making it possible to use different parts of a plant independently); mechanically opated mixer at end of car plant, admitting motor trucks or wagons underneath.

Patented **Steam Heat** Melting!

Guaranteed capacities!

Merriman Plants admirably combine Portability with Efficiency, Low Operating Costs and Uniform High Quality Results.

Full information furnished on request.

THE EAST IRON & MACHINE CO.

Lima, Ohio, U. S. A.

Chicago Office, Marquette Bldg.

LITTLEFORD

TAR AND ASPHALT HEATERS

PATROL HEATER No. 68

Our Modern Roads

with their present day vehicular traffic, demand constant inspection and immediate attention when the surface shows signs of wear. Efficient systems of highway patroling have resulted.

For highway patrol work nothing is more useful or convenient than the **Littleford Patrol Heater No. 68.** Durably constructed with the same careful workmanship and developed to meet special requirements. This heater has been added to the well-known

LITTLEFORD LINE

of portable heating equipment for use of contractors and municipalities in the construction and repair of roads and streets.

Write for our Complete Catalog.

Prompt Shipments from Stock

LITTLEFORD BROS.

460 E. Pearl Street

CINCINNATI, OHIO.

at Steelton, Pa. In April, 1917, he was appointed Assistant State Highway Engineer of New Jersey upon recommendation of General George W. Goethals, then Consulting Engineer to the State. In April, 1918, Mr. Thompson was appointed State Highway Engineer, having full charge of the State Highway Department and its work.

Mr. Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport at the University of Michigan, has recently been appointed Consulting Engineer to the Michigan State Highway Department.

Mr. Charles A. Haskins, Chief Engineer, and Director of the Water and Sewerage Laboratories, of the Kansas State Board of Health, has resigned to associate himself with Black & Veatch, Consulting Engineers, Kansas City, Missouri. Mr. Haskins has been connected with the Kansas State Board of Health for nine years, with the exception of a leave of absence in 1915, spent with the United States Public Health Service in the Investigation of the Pollution of Coastal Waters. Mr. Haskins served during the war as a Captain in the Sanitary Corps, detailed to the office of the Surgeon General on special investigations of water and sewerage problems.

Mr. James W. Routh, C. E., Director and Chief Engineer of the Rochester Bureau of Municipal Research, Inc., Rochester, N. Y., announces that he is available for service as consulting municipal engineer, and is prepared to conduct investigations, prepare plans, specifications and reports, and supervise operations in connection with all municipal engineering activities. Special service can be rendered municipalities interested in improving the organization and administrative procedure of their departments of government. Offices, 501 Arlington Bldg., Rochester, N. Y.

Messrs. Langdon Pearse and Samuel A. Greeley announce that Mr. Paul Hansen, formerly chief of the division of sanitation and engineering of the Illinois State Department of Health, has become a member of their organization. The firm will continue its professional practice under the name of Pearse, Greeley & Hansen, with offices at 39 West Adams Street, Chicago, specializing in water supply, water purification, sewerage, sewage treatment, industrial sanitation, garbage and refuse disposal, valuation, works operation, design, and supervision of construction.

LeRoy K. Sherman, who has had charge of the construction and salvaging of government housing for industrial war workers, has resigned as President of the United States Housing Corporation, Washington, D. C., and has returned to Chicago. Mr. Sherman has become associated with the Edmund T. Perkins Engineering Company as Vice-President. Mr. Sherman is a Civil Engineer and graduate of Massachusetts Institute of Technology. He is President of the American Association of Engineers, and was formerly the engineer member of the Illinois State Rivers and Lakes Commission. The Edmund T. Perkins Engineering Company will conduct a general practice as consulting engineers in municipal and sanitary work in addition to their specialty of land drainage and reclamation.

Dow & Smith, Consulting Paving Engineers, announce that they have established a branch office at Columbia, S. C., at 1327 Main St., which is in charge of T. Keith Legaré, District Engineer. Mr. Legaré was formerly connected with the engineering department of the city of Columbia for eleven years, and has had extensive experience with various types of street paving. After resigning as city engineer of Columbia, he entered private practice as consulting engineer, specializing on municipal engineering, but has recently discontinued this part of his business.

MOTOR TRUCK NOTES

Performance of a Duplex Limited Truck

From Hartford, Connecticut, to Lansing, Michigan, and back between Tuesday noon and early Saturday afternoon is the record of a Duplex Limited Truck according to Russell P. Taber, Inc., Duplex dealers in the Hartford territory. Outside of changing one tire, not a nut or bolt on the truck was touched and the average of gasoline was nearly 10 miles per gallon for the entire trip both ways.

The truck arrived from Hartford with more than 3-tons of rims and bearings. The return trip was made with a load of 5,200 lbs. The Duplex Limited arrived in Hartford fifteen minutes ahead of several other trucks which left Lansing one day earlier.

Truck Stamina

L. Ferger, a New York contractor, who has ten 5½-ton Macks, reports rather unusual emergency service from them. For a period of three months, he says, five of these trucks averaged 220 miles every 24 hours, working continuously to the extent that the motors were never cold. Again during the coal shortage and severe winter of 1918 five more hauled coal day and night for several months. Nine of the ten have never missed a day's service on account of repairs, and the other—a five year old model—just recently required cylinder reboring.

Burley Preston, of Arlington, Wash., has a 2-ton Mack that averaged 149½ miles daily for 830 consecutive days including Sundays and holidays without missing a trip. During these 2 years and 3 months, the truck had a steady 24 hour-a-day grind hauling logs during the day and milk during the night. Constant overloads always exceeding 100 per cent. were a further requisite to Mr. Preston's emergency demands and in spite of all this strenuous service, he can prove that his cost of maintenance for the period was less than one cent a mile.

Schafer and Schafer, also of New York, ran their 5½-ton Mack 24 hours a day 7 days a week always heavily overloaded for 31 consecutive weeks between New York and Philadelphia, without missing a day. It stopped then for a minor repair to one of the wheels, after which it continued the same grind for several months more. Then the Sunday trip was omitted and it has since made the same trip six days a week.

Two Mack AB's in the service of A. E. Buck, East Arlington, Vt., worked 24 hours a day for 5 months on a rush government lumber contract their owner secured. He employed three shifts of drivers, working the trucks day and night and for the five months the motors were never cold. They are now doing the work of 20 teams

and are hauling lumber at the rate of 3,000,000 feet a year.

Gramm-Bernstein Expands

At a meeting of the directors of the Gramm-Bernstein Motor Truck Company, held at the offices ot the Company in Lima, Ohio, on July 31st, a stock dividend of 50 per cent. was declared out of surplus earnings to the common stock holders of record and it was also voted to increase the capitalization from $1,500,000.00 to $5,000,000.00, the entire amount to be issued as common stock.

The company, which has been unusually successful from the start and has averaged earnings of 25 per cent. per annum on its common shares for the past five years, has heretofore been closely controlled by the two principals, Messrs. Gramm and Bernstein, but the quality of its product, the prestige gained from the prominent part which they played in the making of the first Liberty Truck, which was later followed by orders for several thousand additional trucks, has since created such an enlarged demand for their product as to make the increased capitalization necessary for the proper conduct of their future business.

The company has built up a high class and closely knit organization who will now be given an opportunity to share equally with the principals through being given the right to purchase common stock. It is the expressed intention of the principals also to offer a limited amount of the stock to the public.

CONTRACTS AWARDED

ROADS AND STREETS

Ala., Anniston—J. F. Morgan Paving Co., awarded contract for paving Noble and 15 Sts., at $133,851.

Ala., Bessemer—J. S. Morgan Paving Co. awarded contract to pave 1st, 2nd and 4th Aves. and 19th St.; Sullivan, Long & Haggerty, contr. for grading, curbing and sewers. Total cost of work, $269,566.

Ariz., Florence—R. Toohey, Florence, awarded contract in modified form for constructing Secs. 2, 3 and 4, Casa Grande-Tucson Highway. Pinal Co., at $132,332.

Cal., Marysville—Warren Constr. Co. awarded contract for constr. of District 10 Highway, at $191,000.

Cal., Visalia—E. E. Herdman, Visalia, awarded contract for paving Worth-Springville Div. Tulare Co. Highway, 9.09 miles, with 1:2:4 concrete, 4 in. thick, at $11,917. County will furnish materials, estimated to cost $67,067.

Ct., Hartford—Linberg & Street, 294 Washington St., Boston, awarded contract for bldg. 11,400 ft. 3-in. native st. macadam over 7-in. broken stone, Columbia-Vernon Highway, at about $100,000; also contr. for 3,650 ft. highway through Columbia Twp., at $25,000; road work in Brookiyn and Hampton Twps., to J. Arborio, 80 Park St., New Haven, at $200,000; 5,560 ft. Cooks Hill Rd., New Fairfield, to J. De Michael & Bros., 58 High St., Torrington.

D. C., Washington—Cranford Paving Co., Washington, D. C., awarded contract to lay 39,000 sq. yds. sheet asph. pavements. $392,000 available for this and contract awarded to Corson & Gruman, Ocean City, N. J., for 27,000 sq. yds.

Fla., Tavares—J. Y. Yeats Co., Tampa, awarded contract for paving 2 miles streets, 30 and 40 ft. wide, asph. conc., at about $92,000.

Ga., Griffin—Reese & Waldrup Constr. Co., Augusta, Ga., awarded contract to construct 4.9 miles paved road between Griffin and Jackson Rd., at $126,000.

Ga., Moultrie—Atlantic Bitulithic Constr. Co., Washington, D. C., awarded contract to pave streets here at $250,000.

Ga., Winder—Passmore-Davis Constr. Co. Georgia Casualty Bldg., Macon, Ga., awarded contract to construct 17,000 yds. pavement; 7,000 ft. curb; ½-mile sewers, etc. $100,000 available.

Idaho, Blackfoot—J. C. Maguire Co. awarded contr. for 40,000 sq. yds. Warrenite-Bitulithic pavement on 3-in. dense bitum. conc. base.

Idaho, Idaho Falls—J. C. Maguire Co. awarded contr. for 47,684 sq. yds. Warrenite-Bitulithic pavement on 4-in. concrete base.

Idaho, Sand Point—Chas. McKenzie, Colfax, awarded contract for Rd. Proj. 19 (12 miles 22-ft. rdway), from 4 miles north of Sand Point to Bonner Co. line, at $185,000; General Constr. Co., Spokane, awarded contract for 17 miles in Boundary Co., at $198,000. Clyde Chaffins will be resident engineer and inspector on both jobs.

Ill., Springfield—Dept. Pub. Wks. & Bldgs. let contracts for bldg. following sections; Vandalia-Cairo Hwy: Sects. 24A, 25A and 26A, Fayette and Marion counties, to Frazier-Davis Constr. Co., Arcade Bldg., St. Louis, Mo., at $56,000; Sects. 26A and 28A, Marion Co., Sec. 30A, Marion & Washington Cos. Sects. 32A and 33A, Washington Co. to Cameron-Joyce & Co., Keokuk, at $94,841; Sect. 29A, Marion Co., to Embankment Co., Joliet, at $21,623.

Ill., Springfield—Awen & Warfield, Lincoln, awarded contract for grading Springfield-Danville Hwy., at $40,843, and Salisbury Rd., at $25,346.

Ia., Marshalltown—A. Carlson, Marshalltown, awarded contract for Dist. No. 2, at $35,716; Dist. No. 4, $28,681 and Dist. No. 6, at $107,200.

Ind., Indianapolis—Posey & Parsons, Evansville, awarded contr. for grading and culverts on State Hwy. Proj. 16, Sec. F. Dubois Co., at $131,755; Richards & Ellis, Rockport, awarded contr. on grading & culvert work, State Hwy. Proj. 16, Sec. E, Dubois Co., at $83,923.

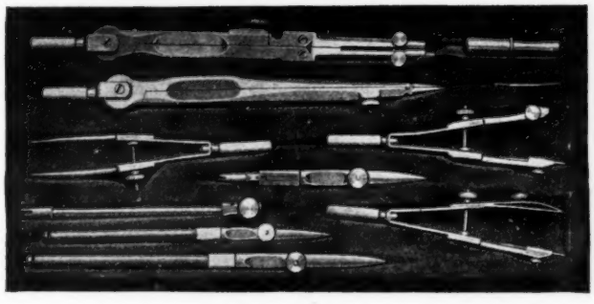
Ia., Osceola—L. L. Beye, Eldorado, Kas., awarded contract for 2 mi. asph. paving, at $152,544.

Ia., Primghar—O'Brien County let contracts for bldg. 5 miles Hwy. involving 52,800 sq. yds. rein. conc. pavement, to J. H. Johnson, Royal, at $208,032 8.5 miles, 89,760 sq. yds. rein. conc. to Capital Constr. Co., Des Moines, at $385,978; 9 mi., 95,040 sq. yds. rein. conc. to O'Rourke Eng. Co., Des Moines, at $403,918; 60,000 lin. ft. tiling, to L. Johnson, Hartley.

Me., Augusta—Greenwood Constr. Co., Showhegan, awarded contract for bldg. 6.12 miles gravel road, Littleton, at $117,987; rebldg. Gagnon brdg. Frenchville, to Bd. Selectment, Frenchville, at $10,800.

Mass., Boston—C. Bianchi & Co. Inc., Framingham, awarded contract by State Hwy. Comn. for bldg. 3,300 ft. highway, Leicester, at $61,023; Warren Bros. Co. 142 Berkeley St. awarded contract for paving Clarendon St., bitulithic, at $12,614; 1,162 ft. Blackstone St. to J. Landis, at $18,633.

Mich., Harrisville—Hill & Lonte, Whittemore, awarded contract for grading and



No. F 1854, 5½-in.

COMPASS DRAWING SET

As illustrated

By Mail, $7.50

Write for description of other sets.

Drawing Instruments, Surveying Instruments and Surveyors' Supplies.

KOLESCH & CO., Established 1885 138 Fulton St., New York

surfacing & draining 5.938 mi. F. A. Rd. 33, Sec. A, involving 62,434 sq. yds. gravel, 930 lin. ft. pipe culvts., 419 cu. yds. concrete in culvts. etc., 175 lin. ft. guard, at $103,145.

Mich., Lansing—Road Comn., Muskegon, Co. Muskegon, awarded contr. for surfacing and grading 3.956 mi. F. Aid Rd. 1, Sec. A, 16 ft. wide, at $120,709; T. W. Edison, Rogers, awarded contract for grading, draining and surfacing 5.938 mi. F. A. Rd. 33, Sec. B, 16 ft. wide, Alaecona Co., involving 24,926 cu. yds. earth excav., gravel surfacing, steel reinforcement, culverts, etc., at $77,895.

Minn., Caledonia—Thornton Bros. Co., 304 Central Bank Bldg., St. Paul, awarded contract for road work, at $237,762.

Minn., Duluth—Foley Bros. & Nelson, St. Paul, awarded general contr. for constr. of 3.1 miles rd. constituting Carlton Co. approach to Fond du Lac brdg. over St. Louis river, at $75,720.

Minn., Little Falls—General Contg Co., 1228 Plymouth Bldg., Minneapolis, awarded contr. for pav. abt. 14 blks. 1st St. S. E., 2nd to 6th Aves., involving 38,000 sq. yds. bitulithic on macadam foundation, at about $150,000.

Minn., Mora—J. J. & M. S. Mergens, 403 Kasota Bldg., Minneapolis, Minn., awarded contracts for F. A. P. No. 91, State Rd. No. 2, at $139,000.

Minn., Rush City—W. S. Harris Co., Minneapolis, and C. Johnson, Sandstone, awarded contr. for 7 mi. conc. paving and 33 mi. grading on Fed. Aid Proj. 95, State Rds. 5, 2 and 1, at total of $488,000.

Mo., Carthage—Carterville Constr. Co., awarded contract for street paving to amt. of $220,000.

Mo., St. Louis—Board Pub. Wks. awarded following contracts: O. S. Brighton, reconstruct Marcus, Lawton, Lafayette and Union Aves., at $222,865; Granite Bitum. Paving Co., contract to improve Skinker Rd. and Maple Ave., at $64,093.

Mont., Gt. Falls—S. Birch & Sons, awarded contr. for 13,000 sq. yds. Warrenite-Bitulithic pavement on 4-in. concrete base.

N. J., Hoboken—W. T. S. Crichfield, Washington St., awarded contract for improvement of 1st St., at $93,805; Monroe St., 8th to 9th Sts. and various other streets, Blegium blk., to Letteri & Belezza, Jersey City, at $791,245.

N. J., New Brunswick—H. N. Scott, Cranbury, awarded contract subject to approval of State Hwy. Comn., of Helmetta Rd. Impvt., at $74,379.

O., Akron—Columbia Asphalt Co., 708 2nd Natl. Bank Bldg., awarded contract for paving Silver Lake Blvd., at about $160,000.

O., Alliance—Highway Construction Co., awarded contract for rebuldg. abt. 4 mi. of Alliance-Limaville Rd., at $92,000.

O., St. Clairsville—McClain Constr. Co., Bellaire, awarded contract for paving 2 miles Flushing-Uniontown Rd., concrete, at $78,000; 2.5 miles Martins Ferry-Colerain Rd., brick, to Clifford & Shannafelt, Bellaire, at $110,000.

Okla., Lawton—Allen & Harrison, Okla. City, awarded contract to construct 6 mi. gravel road in Comanche Co., at $73,401.

Ore., Astoria—Northwest Constr. Co., Portland, awarded contracts involving expendt. totaling $189,226 for street impvts. Bids include bulkheads, sand or earth fill, necessary anchor rods, walks, etc.

Ore., The Dalles—United Contractg. Co., awarded contr. for 12,547 sq. yds. Warrenite-Bitulithic pavement on 4-in. compressed stone base.

Pa., Harrisburg—C. E. Weed, Inc., Albany, N. Y., awarded contract for 2,635 ft. one-course rein. conc. 18 to 29 ft. wide, Delaware Co., Millbourne Boro. and Upper Darby Twp., Route 133, at $36,084; also 7,441 ft. one-course rein. conc., 18 to 33 ft. wide, Northampton Co., Bangor Boro., at $110,673; M. Bennett & Son, Indiana, Pa., contr. for 13,625 ft. one-course rein. conc., 18 ft. wide, Westmoreland Co., Derry Twp., State-aid application No. 965, at $190,030.

R. I., Providence—J. Bristow, Narragansett Pier, awarded contr. by State Bd. Pub. Rds. State House, for bldg. 2 miles of rd. from 1,000 ft. so. of Nanaquaket Brdg. so. on Sakonnet Point Rd. town of Tiverton, at $87,652.

S. C., Columbia—White & Simpson, Chatham, Va., awarded contract for bldg. 20 miles Columbia-Saluda Rd. gravel, at abt. $123,000.

Tenn., Bristol—Municipal Paving & Construction Co., awarded contract for street impvt. work, estimated at $115,000. Work includes 7 districts.

Tenn., Selmer—Evans & Meade, Florence, Ala., awarded contract to construct roads; $600,000 available.

Tex., Henderson—Tipple Constr. Co., Mineral Wells, Tex., awarded contract to construct 45 miles of roads, at $350,000.

Tex., San Antonio—Southwestern Bitulithic Co. and Uvalde Co., awarded contracts to pave 21 streets, Uvalde rock asph. and bitulithic; 24-in. pavements on macadam base, at $560,000.

Tex., Van Horn—W. E. Hamilton, Mineral Wells, awarded contracts for improving 23.356 mi. Hwy. 12, 9 ft. wide; also 43,167 mi. Hwy. 1, 9 ft. wide, at $31,984 and $114,990 respectively.

Tex., Wichita Falls—Potts & Prentice, awarded contract to improve 8.81 miles highway; Fed. Aid Proj. No. 3; 4.68 mi. Hwy. No. 3, F. A. Proj. 61; concrete, at $648,845.

Vt., Montpelier—G. L. Gregoire & Co., Barre, awarded contract for bldg. 1.26 mi. State Hwy. Proj. 16, E. Montpelier, involving 2,910 cu. yds. gravel, 139.5 cu. yds. conc., 5,827 cu. yds. earth and 100 cu. yds. rock excav., 2,533 cu. yds. stone base, 1,381 cu. yds. borrow, etc., at $35,852; 4.03 miles Proj. 15, So. Burlington and Shelburne, to W. T. Thayer & Co., Chateaugay, N. Y., at $119,967; 5.6 mi. Proj. 14, Dummerston, 14,106 sq. yds. gravel, 546 cu. yds. conc. 1,497 cu. yds. bitum. macadam, etc., etc., to Fallkill Constr. Co., 1 Washington St., Poughkeepsie, N. Y., at $124,083.

Wash., Vancouver—Warren Constr. Co., awarded contr. for 33,700 sq. yds. Warrenite-Bitulithic pavement on 4 in. compressed stone base.

W. Va., Charleston—Kanawha County Commrs., awarded following contracts: Abbott Bros., Sec. 4; Towles & Company, Princeton, W. Va., Sects. 5 and 6; Randish Constr. Co., Sec. 8, on Paint Crk. Total amt. of contracts, $271,000.

W. Va., Moundsville—N. M. Leigh, Mannington, W. Va., awarded contract to grade and drain 3 miles Cameron & Poplar Spgs. rd., at $138,000.

Wis., Superior—M. Peabody, Young & Co., St. Paul, Minn., awarded contract for Sec. 2 & 3, State Hwy. 35, at $561,122.

SEWERAGE AND SEWAGE TREATMENT

Ala., Bessemer—Sullivan, Long & Hagerty, awarded contract to construct storm sewers on 20th and 22nd streets, also pave streets, at $269,566.

Ariz., Phoenix—Ford, Morgan & Co., awarded contract for 20 mi. of trenching and backfilling on Verde river pipe line, at about $80,000. Comn. will do the trenching on another 6 miles.

Cal., Los Angeles—M. Chutuk, 1506 Pleasant Ave., awarded contract for constructing cement pipe sewer in 85th St. and Moneta Ave., sewer district, at $33,629; R. D. Zaich, 220 W. 56th St. contract for cement pipe sewer in 2nd Ave., at $1,999.

Cal., Los Angeles—Following contracts awarded by Bd. Pub. Wks.: Leo Miletich, 610 W. 54th St., vit. pipe sewer in Mariposaa Ave., at $2,100; also cement pipe sewer in 81st St. and Hoover St. Dist., at $17,773; B. Deragno, 1614 S. Hill St., cement pipe sewer in New Hampshire Ave., at $1,797; A. J. Wuletich, 1948 E. 2nd St. cement pipe sewer in San Pedro St. & Florence Ave. Dist., at $32,970; B. D. Zaich, 220 W. 56th St., cement pipe sewer in 68th St. Dist., at $25,400; S. Zarufica, 3006 6th Ave., vit. pipe sewer in Helios Dr. Dist., at $5,187.

Colo., Ft. Collins—M. Johnson & Co., Boulder, awarded contract for bldg. storm sewers in Whitcomb and Whedbess Sts. and Oak and Laurel Sts., at about $102,000.

Conn., New Haven—Dwyer & Mannix, 333 Sheldon Ave., awarded contr. for bldg. 6,000 ft. sewer in Westville Sect., at $31,365.

Conn., W. Haven (New Haven, P. O.)—Dwyer & Mannix, 335 Shelton Ave., New Haven, awarded contract for bldg. storm sewers in various streets, at about $25,000.

Ida., Nampa—Helm & Davis, Boise, awarded contract for constr. of 17 miles of lateral sewerage, at $208,000.

Ia., Bancroft—O. N. Gfellefald, Forest City, awarded contract for constr. of sewer system; $86,000; disp. plant, to H. R. Ash.

Mass., Boston—Antony Cefalo, awarded contract for sewerage works in private land and Babcock St., between Salt Creek outlet and Commonwealth Ave., Brighton, at $10,217.

Mass., Boston—Jas. J. Conway, awarded contract for bldg. sewerage works in Chestnut Hill Ave., Brighton, at $12,484; Jos. Todesca, awarded contract for sewerage work in private land and Paine St., near Brook St., West Roxbury, at $6,134.

Mass., Lynn—A. Cefalo, 316 Belgrade Ave., Roslindale, awarded contract for bldg. vitr. pipe sewer in Market St., at $73,651.

Mich., Detroit—City let contr. to N. Mancini, 580 Concord Ave., for bldg., Springle Ave., san. sewer, at $57,750; W. Blanck & Co., 827 Ford Bldg.; Jno. R. Arm, $57,145; to J. Porath, 23 McGraw Bldg., Swift Ave., Arm, Puritan Ave., Arm and Oakland Ave., Arm., $66,550, $65,912 and $54,840 respectively.

Mich., Pontiac—Dan Stevens, local, awarded contract for constr. of san. sewer in Ardmore St., from main sewer to E. Pike St., at $1,447; Geo. Pontarelli, Chicago, awarded contract for 1st section of main sewer to be built with part of the $550,000 voted for san. sewer purposes. This is an open ditch job and extends from city's present outlet to Union St. and parallels the Clinton river. Contractor offered to take work at $21 per ft. for 84-in. sewer; $23 for 48-in. pipe, $4,500 for putting sewer under river at one point where it is necessary; $200 for special manhole; $100 each for 9 stand. manholes; $2 cu. yd. for moving earth where it is desirous of straightening river and altering present course. Bids will be called for and opened Oct. 4, at City Hall for Sections 2 and 3 of this sewer, (tunnel work). City Clk. Luebke.

Minn., LeRoy—O'Neil & Preston, Minneapolis, awarded contract for sanitary sewers, at $52,000; 20,000 ft. 8 to 12-in. sewer.

Minn., Mankato—Following contracts let for Ditch No. 57: Tile work to Frank F. Esser, local, at $136,000; open work, to Mulgrew & Sons, Dubuque, at $15,000, also spreading spoil bks., $300 per lin. mile.

Minn., Pine Island—J. G. Rae, Tracy, Minn., awarded contract to complete san. sewer system, at $40,577; 7 to 15-in. sewer, 5 to 15-ft. deep.

S. D., Rapid City—Geo. M. McDonough, awarded contract for storm sewers.

Mo., Kansas City—M. Walsh & Son, awarded contract for constr. of sewer in alley between Baltimore Ave. and Main St., from 18th to 21st Sts., at $35,930.

Mo., Kansas City—Kinlen Constr. Co., awarded contr. for bldg. comb. storm and san. sewer in district south of 65th St., at $31,330.

Mo., Kansas City—T. M. Torson Constr. Co., 362 S. 10th St., Kansas City, Mo., awarded contract for constr. of sewer at $118,575; W. D. Boyle Constr. Co., 709 Railway Exch. Bldg., Kansas City, Mo., for constr. of sewer, at $14,985.

Neb., Alma—Art. A. Dobson Co., Lincoln, awarded contract for constr. of complete sewerage system for city, at $69,009.

N. J., Haddonfield—W. P. Corson, 1141 Sycamore St., Camden, awarded contr. for bldg. 2 sewage disp. plants and laying one mile terra cotta sewer pipe, at about $130,000.

N. J., Irvington (Newark P. O.)—J. Doren, 646 Nye Ave., awarded contr. for bldg. sewer and paving in Alpine St., Grove to 21st Sts, at $16,600.

N. D., Hankinson—Jno. O'Connor Co., Fargo, awarded contract for complete sewer system, including septic tank and sludge bed, at $82,000.

O., Cleveland—Gallagher-Burge Constr. co., awarded contract for construction of sewer in Scoville Ave., at $90,000; A. J. Galvin, awarded contract for constr. of sewer in Nelson Ave., Sec. 99th to 112th St., at $28,200.

O., Cleveland—W. McDowel & Son, 10319 Miles Ave., awarded contr. for bldg. sewers in Miles Ave., from old to new city limits, at $30,879; Nelson Ave., E. 99th to E. 112th Sts.; A. J. Galvin, 343 The Arcade, at $28,200; Ferris Ave., E. 123rd to E. 131st Sts., to Stevens & McKeon, 343 The Arcade, at $5,980. Work involves 1,660 ft. 4-in. egg shaped rein. conc. and 3,110 ft. 12-in. vitr. pipe, 1,800 ft. 2-in. B and C tile blocks, etc.

O., Cuyahoga Falls—Wm. H. Hunt Sons, Akron, O., awarded contract for 15,000 ft. vit. pipe sewer; 15,000 cu. yds. excav., 32 manholes, at $32,745.

O., Xenia—City let contract for bldg. sewer extension in Dists. 1, 2, 3, 5 and 6, to J. C. Mercer & Son, Piqua, at $28,628.

Pa., Philadelphia—A. Jafolla, awarded contract for constr. of new sewer in Octalaune St., at $190,000; J. J. McHugh, contr. for constr. of branch sewer in Olney Ave., at $30,000.

Pa., Pittsburgh—The Foundation Co., Pittsburgh, awarded contr. for bldg. pump house and suction tunnel for Carnegie Steel Co. at its Mingo plant at Mingo, on Ohio river, at $100,000.

S. C., Chester—Tucker & Laxtor, Charlotte, N. C., awarded contract to install sewer system on mill property at $28,000.

S. C., Hartsville—Howerton-Tinsway Co., Asheville, N. C., awarded contr. to extend sewer system; construct 9,800 ft. 8 and 10-in. sewers, at $34,228.

Wash., Spokane—Miller & Paulsen, local, awarded contracts for installing sub-trunk and lateral sewers on Maxwell Ave., at $16,745.

Wis., Kilbourn—Henry E. Wolff, Winona, Minn., awarded contr. for Sand Rock tunnel, outfall pipe sewer and lat. connections, at $30,000.

Wis., Milwaukee—Knowles & Fehr, 314

North Dearborn St., Chicago, awarded contract for bldg. 595 ft. 30-in. cast iron syphon and 2 valve chambers in Concord and Auer Aves., at $47,030.

WATER SUPPLY AND PURIFICATION

Ariz., Phoenix—Ford, Morgan & Co., awarded contract for excavating and backfilling 20 miles for wood stave pipe line for water supply, at $80,000; 6 miles to R. E. Shea, at $18,000.

Alta., Edmonton—Roberts Filter Co., Inc., Darby, Phila., Pa., awarded contr. for 4 new filters for local plant, at $45,200.

B. C., Courtenay—Foundation Co., Ltd., Victoria, awarded contr. (general) for water works, costing $110,000.

N. S., Dartmouth—Thos. Lahey, Water St., awarded contr. (general) for constr. of water and sewer extensions, costing $100,000.

Ont., Hawksbury—Town will construct water works system; also sewerage system, by day labor. Work will involve 15,000 ft. 16-in. cast iron pipe. Abt. $65,000. V. E. Belanger, Hawkesbury, Engr., will have charge of work.

Ont., Sandwich—Webster Constr. Co., Bank of Toronto Bldg., London, awarded contract for laying new 4-in. water mains and 10 and 12-in. sewers for city.

Ill., Crystal Lake—C. M. Porter, 111 Wash. St., Chicago, awarded contract for bldg. extensions to main water supply system, at $76,344.

Kans., Arcadia—E. L. Garrettson & Bros., Ft. Scott, awarded contract for improving water works systems, at about $30,000.

Mass., Boston—Frank Drinkwater, awarded contr. for laying and relaying water pipe in Burt St., Fuller St. and Thetford Ave., Dorchester, at $6,895; Mechanics Iron Fdy. Co., for furnishing iron castings to Water Div., 70,050 lbs. No. 2 castings at 6.5c per lb.; National Water Main Co., Inc., contr. for cleaning water pipes in Carolina and Chestnut Aves., Chestnut Sq., Union Ave., Jamaica, Newbern, Oakdale, Sedgwick, Sherwood and Sycamore St., Union Ave. and Wenham St., at $3,115.

Minn., Albert Lea—McManis & Tarnoski, 484 Endicott Bldg., St. Paul, awarded contract for bldg. 1,500,000-gal. reservoir; also pressure concrete tank, 140 ft. high, at about $70,000.

Minn., Ely—Following contracts let for alterations to bldg. of municipal water and light plant: L. M. Bartlett, 604 Builders' Exch. Bldg., Minneapolis, $14,960; piping, American Htg. Co., 228 W. Mich. St., Duluth, $17,700; boilers previously awarded to Heiner Bouler Co.

N. C., Gastonia—B. F. Roberts, Gastonia, awarded contract to lay 4½ miles 12-in. and 2 miles 8, 3½, 6 c. j. water mains.

N. D., Hankinson—W. D. Lovell, Minneapolis, awarded contract to complete water works system, including wells, reservoirs, tower, tank, flanges, etc., at $151,000.

O., Eaton—Burgess & Nitle, Columbus, awarded contract for bldg. new filtration plant, at about $25,000.

Pa., Philadelphia—Cuthbert Bros. Co., Bessemer Bldg., awarded contract for constructing 2-sty. 28x60-ft. rein. conc. bldg. for water purification plant, capy. 20,000 gal. per hr., at about $35,000.

Tex., Cisco—H. F. Friedstedt, Chicago, Ill., awarded contract to construct dam over Sandy river, 3 miles from city; Ambrusen type; rein. hollow conc.; 1,320 ft. long; 125 ft. high; impound 15,000,000,000 gals. water, covering 1,000 acres at average depth of 75 ft. Specfs. call for 37,000 yds. conc., 12,000 lns. asph., 1,500,000 lbs. reinforcing steel, 95,000 yds. excav., etc., at $915,000.

Tex., San Antonio—Globe Automatic Sprinkler Co., Dallas, awarded contract for dry automatic sprinkler system, at $132,000.

Tex., Galveston—J. W. Zempter, Galveston, awarded contract to constr. reservoir, 1,750,000-gal. capy. (concrete), at $41,914.

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Talladega—State Hwy. Comn., Birmingham, plans to construct 22 mile roadway in Talladega Co., $250,000.

Ark., Little Rock—Petition of St. Impvt. Dist. 288, to pave W. 7th St., Center to Victory St. granted. Present plan is to pave with asphalt.

Cal., Hemet—Petitions being circulated for formation of road impvt. district to pave nearly 6 miles Florida Ave., from end of paving at Cornell St. to W. R. Whittier ranch, east of Valle Vista. Est. cost $9,000 per mile. Prelim. plans and specfs. have been prepared by C. Fulmor, Co. Engr., Riverside Co.

Cal., Los Angeles—Ords. adopted for St. work by council as follows: Wheeling Way, Ebey Ave. to Walnut Hill Ave., to be graded and oiled and cement curb, walk and gutter to be constructed. Berkeley Ave., Lemoyne St. to Lake Shore Ave., similar work; 58th St. from 200 ft. east to 200 ft. west of Long Beach Ave., to be graded and paved with conc. base and asphaltic coaring surf. and constr. of cement curb, walk, gutter and vitr. pipe house connection sewers; Talmadge St., Sunset Dr. to Clayton Ave. and portions of other Sts. in Talmadge and Clayton Impvt. Dist., to be graded and oiled, cement curb, walk and conc. culvert to be built.

Cal., Santa Ana—Co. Engr. J. L. McBride, has completed plans for paving with concrete about one mile of highway in Fairview sec., extending from end of present paving below Greenville to Old Fairview Hot Springs hotel. Bids will be asked soon. Gravel will be hauled from old Santiago creek.

Cal., Taft—Resolution adopted by City Trustees to pave portions of Main, North, Third, Fourth and Fifth Sts. with concrete.

Conn., New Haven—City contemplates paving 32,000 sq. yds. various streets; concrete, asphalt or bitum. macadam., F. L. Ford, city Engr.

Ga., Athens—$160,000 available in Clarke county for constructing 3.5 miles hard surfaced roads; R. T. Goodwyn Jr. Div. Engr., State Hwy. Dept.

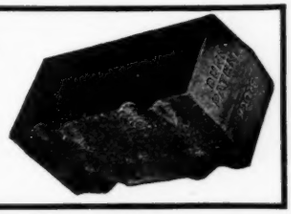
Ida., Caldwell—7th Ave., city hall to Cleveland Blvd., is to be made into a blvd. with parking strip in center of street and paved immediately.

Ida., Nampa—City contemplates paving 34 blocks, est cost $237,000.

Ill., Carlinville—Local Bd. of Impvts. has approved paving of Charles St. New pav-

THE CUMMER ROAD ASPHALT PLANT
THREE SIZES THREE UNITS
Capacity 750, 1250 and 1800 Square Yards 2-inch Top or Macadam Daily
THE CUMMER ONE-CAR ASPHALT PLANT
Capacity 2000 Square Yards 2-inch Top or Macadam Daily
THE F. D. CUMMER & SON COMPANY
CLEVELAND, OHIO New York Office, 19 West 44th Street

MURPHYSBORO PAVING BRICK COMPANY
Equal to the Best
"EGYPTIAN" BLOCK
Surpassed by None
MURPHYSBORO, ILLS.
PROMPT DELIVERIES. LET US QUOTE YOU PRICES.

If you want a sure, durable and reliable road surface, buy
MEDAL BLOCK
The Block with experience behind it.
Oldest in service. Unexcelled in quality
Medal Paving Brick Company
CLEVELAND, O.


UVALDE
ASPHALT PAVING COMPANY
1 Broadway, NEW YORK.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Company

Air Lift Pumps
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Barber Asphalt Co.
Bitoslag Paving Co.
The Barrett Co.
New Orleans Refining Co.
Pioneer Asphalt Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Bitoslag Paving Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The

Asphalt Plants.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Railroad Plants.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Surface Heaters.
Barber Asphalt Paving Co.

Asphalt Tools.
Barber Asphalt Paving Co.
Warren Bros. Co.

Asphalt Tool Wagons.
Barber Asphalt Paving Co.

Auto Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Co., The
Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Barber Brand Cold Repair Cement.
Barber Asphalt Paving Co.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Bermudez Road Asphalt.
Barber Asphalt Paving Co.

Binders, Road.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bodies, Dump—Motor Truck.
Columbian Steel Tank Co.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Pawling and Harnischfeger.

Buckets, Grab.
Mead-Morrison Mfg. Co.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
American Cast Iron Pipe. Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement, Portland.
Portland Cement Association.

Cement Testing.
Kirschbaum, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Centrifugal Pumps.
De Laval Steam Turbine Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The.

Concrete, Reinforcement.
American Steel & Wire Company
Truscon Steel Co.

Concrete Sewer Pipe.
De Smet Quartz Tile Co.

Concrete, Tanks.
Mensch, L. J.

Concrete Tile.
De Smet Quartz Tile Co.

Conduits.
Cannelton Sewer Pipe Co.
Philip Carey Co., The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith
Flood, Walter H., & Co.
Samuel A. Greeley
Howard, J. W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander
Shields, W. S.
Van Trump, Isaac.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The.

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The
Storms Mfg. Co.

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Culvert Pipe, Vitrified.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co., The

Dump Wagons.
Austin-Western Road Machinery Co., The

Dust Laying Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Elastite.
Philip Carey Co., The.

Electrical Wires & Cables.
American Steel & Wire Company

Elevating Graders.
Austin-Western Road Machinery Co

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The.

Expansion Joint Compound.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
Sinclair Refining Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Grab Buckets.
Mead-Morrison Mfg. Co.

Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Gravel Screener and Loader.
The Jordan & Steele Mfg. Co., Inc.
Good Roads Machinery Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists—Motor Truck.
Columbian Steel Tank Co.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Iron Fence.
Cincinnati Iron Fence Co.

Joint Fillers (Paving).
The Barrett Co.
Philip Carey Co., The.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.

ing will include extension south, known as Mayo St. This street will be paved as far south as Hoehn St. On north end Charles St. will be joined by pavement with N. Broad St. by paving of Rice St. in Stand. addition.

Ill., Peoria—Council authorizes three Sts. improved as follows: Sheet asph. on North, South and West Eleanor Pl. and Broadway Way, at est. cost of $56,859; vitr. block on W. Nebraska Ave., Knoxville Ave. to North St., $15,111; sheet asph. on E. Republic St.;Wisconsin Ave. to Pacific St., at $24,053.

Ind., Indianapolis—Board Pub. Wks. approved plans for widening and resurfacing N. Delaware St. between 16th and 19th Sts. Report of City Engr. F. C. Lingenfelter, shows cost of work est: at $28,884, including street and alley intersections.

Kans., Wichita—Board of City Commrs., city Mgr. and city Atty. will meet county Commrs. to make arrangements for paving S. Lawrence Ave., from Kinkard Ave. to existing hard surf. road, about ⅝ of a mile.

La., New Orleans—Work will start on the paving of 21 streets in city. 16 on this side of river and 5 on the other.

Minn., St. Cloud—Resolutions passed favoring road impvts. as follows: Grading 15th Ave., S. 7th to 10th Sts.; grading 12th Ave., S. 7th to 8th Sts.; grading 22nd Ave., N. 2nd to 3rd Sts.; walk and curb on 8th St., 7th to 9th Aves; turnpiking 29th Ave., N. 8th to 10th Sts.

Mo., Joplin—Council has ordered 17 blks. of paving; bitum. macad.; one layer to be applied annually for five years. Byers Ave. Proj. will cost $10,808; Wall St. paving not to exceed $8,712 for the 5-yr. period.

Mo., Kansas City—Repairs have been ordered on following Sts.: Repair asph. pavement on sections of Belleview, Illinois, Norton, 13th, 26th and 27th Sts.; repair conc. pavement on Ewing, Norton and Wyandotte; repair macadam. pavement on Harrison, Terrace, 27th; repair brick pavement on section of Montgall.

Mo., St. Louis—City plans to resurface 4,500 ft. Cabanne Ave., bitum. macadam., $32,700; grade and curb 900 ft. Ester Ave.; $7,250; pave Elizabeth Ave., 3,800 sq. yds. brick, $41,600; miscellaneous alleys, 8,800 sq. yds. conc. and 2,000 sq. yds. brick, $26,000 and $6,750 respectively. W. W. Horner, City Hall, Engr.

Mo., Springfield—Engr. Fuller working on plans for widening Olive St. It is intention to widen the thoroughfare from Main to Benton to stand. width of 60 ft.

Neb., N. Platte—Chas. McNamara, Engr., N. Platte, appointed to make plans for paving on 4th and 5th Sts. Material undecided. O. E. Elder, City Clk.

Neb., Omaha—Resolutions passed to pave W. Leavenworth, 48th to 60th Sts.

Neb., Papillion—Co. Bd. petitioned to construct concrete paving on Bellevue Blvd., about 4 miles. Abt. $42,000 per mile. Tom Dooley, Co. Aud. Sarpy Co.

N. J., Bayonne—Plans and specfs. being prepared for impvt. of W. 10th St., Ave. A to Ave. C, rein. conc. Abt. $50,000. C. O'Neil, Clerk.

N. J., Paterson—Board of Pub. Wks. has requested appropriations of $57,000 for paving, and $30,000 for sewers.

N. H., Concord—State Hwy. Comn. plans to construct Southside Road, Portsmouth, at about $25,000.

N. Y., Schenectady—Little opposition to paving of Sacandaga Rd., Scotia, developed at special meeting of Scotia Bd. of Trustees and residents of Sacandaga Rd.

Okla., Ada—City Commrs. considering the readvertisement for bids for paving of Dists. Nos. 6 to 11 inclusive. Approx. cost of work $850,000. Johnson & Benham, Cons. Engrs., 8th floor, Firestone Bldg., Kansas City, Mo.

Okla., Chandler—V. V. Long & Co., Cons. Engrs., 1300 Colcord Bldg., Oklahoma City, have been selected to prepare plans and proceedings, etc., for repaving business district. Material not yet selected. Est. cost $150,000. D. D. Landsaw, City Clk.

Okla., Purcell—City contemplates paving impvts. estimated to cost $200,000. Johnson & Benham, Cons. Engrs., 8th floor, Firestone Bldg., Kansas City, Mo.

Ore., Portland—City Commr. Barbur, announces that plans of City Engr. Laurgaard, have been accepted for impvt. of Ravensview Dr. and Terrace Rd., Portland Heights. Heavy concrete pavement will be laid, owing to steep slant of hill and car trks. will be moved.

Pa., Beaver Falls—Council has voted in favor of paving 7th Ave., 9th St. to 14th St., with asph., to width of 30 ft. on one side. Est. cost $12,000. Asph. will be laid over the brk. as a base.

Pa., Beaver Falls—Three ordinances passed by Council for paving, guttering and grading 14th St., from 7th Ave. to 8th Ave. and from 9th to 11th Sts.

S. C., Spartanburg—Councilmen checking over names of citizens who have signed petitions asking for election to decide whether city shall issue $200,000 worth of bonds for street, sewerage and park impvts. 1,400 signatures have been obtained.

Tex., Benjamin—$100,000 bonds voted to construct various roads in Knox Co. to include Hwys. 28 and 30. J. M. Morgan, Co.

Tex., Big Springs—$300,000 bonds voted to build roads in Howard Co. State Hwy. Comn. granted $125,000 Fed. Aid (not to exceed 50% of cost) for bldg. Hwy. 1. S. A. Penix, Co. Judge.

Tex., Coleman—Coleman Co. has completed surveys and plans are being prepared for grading, surfacing & bldg. bridgs. on 22.5 miles Hwy. 23 from here to Callahan Co., 16 ft. wide. Est. abt. $320,427. E. E. Dickerson, Co. Engr.

Tenn., Knoxville—Bond issue of approx. $60,000, for which Ord. has been passed by City Comn., represents cost of grading and paving portions of several sts. and aves. in city.

Tex., Nacogdoches—County having plans prepared for grading, gravel surfacing and draining 23.17 miles Hwy. 21, from here to San Augustine Co. line, 16 ft. wide, involving 160 acres clearing and grubbing, 210,000 cu. yds. earth excav., 950 cu. yds. conc., 46,340 cu. yds., gravel, 100,000 lbs., reinforcing and 300,000 lbs. fabric steel, Abt. $288,144. Fed. Govt. will appropriate $100,212 toward cost. L. Acker, Co. Engr.

Wash., Kelso—Council considering construction of 90 or 100 street crossings in impvt. districts.

Wash., Spokane—Under direction of Co. Surveyor Robt. A. Birch, surveys are being run for new rd. betw. Montpelier and Geneva. Work of survey will soon be completed, after which it is intended to immediately start construction work.

W. Va., Martinsburg—Berkeley Co. Commissioners will hard-surface 3-mile road between Cumberland Valley bridge and Wellton, Hedgeville Dist.; Kentucky rock asph., $63,000. C. N. Stucker, Engr., Martinsburg.

SEWERAGE AND SEWAGE TREATMENT

Cal., Calipatria—E. M. Lynch, Central Bldg., Los Angeles, preparing plans for lateral sewers in business district, which are in addn. to contract of H. H. Peterson, of Calexico.

Cal., Newport Beach—Resolution adopted by City Trustees to constr. cement pipe sewer sys., septic tank and 3 sewage pumping stations; work to be done under Vrooman Act.

Cal., Stockton—Prelim. ests. prepared for bldg. storm sewers in various streets. W. B. Hogan, City Engr.

Ont., Toronto—City plans to construct 900-ft. trunk sewer in York St., King to Front Sts.; 6-ft. diam. concrete or brick. Abt. $29,668. R. C. Harris, City Engr.

Ill., Chicago—N. Shore San. Dist., comprising Highland Pk. Lake Forest and Waukegan, will construct additional sewage disp. plant for Highland Park, costing $50,000 and impvts. to 2 existing settling tanks, amounting to $20,000; constr. of sewage treat. plant in Waukegan costing $186,000 and other impvts. totaling $266,000. Plan also includes sinking of several test deep wells in Highland Park.

Ill., Kankakee—Petition filed by property owners in Riverview Dist., for bldg. new sewer. Proposed san. drainage will reach all of the Electric Pk. Dist. Est. cost $21,500.

Ill., Lincoln—Town contemplates bldg. sewage disp. plant. Pollution of the waters of Salt Crk., near source of city's water supply, has given project fresh impetus.

Ill, Maroa—Bd. Local Impvts. contemplates constr. of sewerage system with sewage treat. plant about ½-mile west of city. Alex Van Praag, Jr., Dept. of Pub. Health, Springfield, together with Capt. C. R. Andrew, of firm of Miller, Holbrook, Warren & Co., have visited town and gone over proposed plans for drainage. Jas. A. Worsham, mayor.

Ill., Moweaqua—Resolution adopted by Bd. Local Impvts. authorizing constr. of complete sewerage system here and sewage treat. plant, at cost of $110,000. Pipe ranges in size from 8 to 24 ins., the provision for two storm water inlets doing away with larger size sewers. Treatment plant will be Imhoff type. System involves about 14 miles of sewers. Miller, Holbrook, Warren & Co., Cons. Engrs., Decatur, designed system. Judge S. S. Clapper, city, is attorney.

Ky., Louisville—City comtemplates constructing sewers at cost of $80,000. Thos. B. Crutcher, chairman of Board.

Mass., Boston—Commr. of Pub. Works states it is his intention to constr. surf. drain of 2 ft. 6 in. conc. and 18 in. earthen pipe and 2 catch-basins, in private land and Paine St. betw. Paine and Canterbury branch of Stonybrook, W. Roxbury Dist. Est., cost $7,883; to construct one chamber and equipt. for 18-in. regulator in Tremont St. at E. Dedham St. city proper dist. at est. cost $3,000; to constr. 33 catch basins and connects. in Wash. St. betw. Archdale Rd. and Ashland St. in West Roxbury Dist. at est. cost $6,500; to constr. surf. drain 4-ft. circular conc. and san. sewer of 15-in. earthen pipe in private land; surf. drains 3-ft.. 9-in. circ. conc. and 22-in. by 16-in. by 10-in. earthen pipe in Wren St.; san. sewer 15-in. and 8-in. earthen pipe in Wren St.; surf. drains 2-ft. 6-in. and 2-ft. 9-in. circ. conc. and 24-in. and 18-in. earthen pipe and san. sewer of 12-in. and 8-in. earthen pipe in Bd. of Survey street 664 in W. Roxbury Dist. Est. cost $46,814; constr. surf. drain 15-in. and 12-in. earthen pipe and 6 catch basins in River St., Hyde Park Dist., $6,767.

Mich, Holland—Holland has appointed committee to investigate data and figures for solving sewer problem.

Mich., Marquette—City plans to construct sewer on Ashmun St. and Portage Ave. to Peck St., at the Soo. Est. cost, $27,300.

Mich., Marquette—City plans to constr. 6-in. vitr. pipe san. lateral sewer from present manhole at intersection of Div. and Mesnard Sts., so. in Division St. 225 ft. to Craig, and west in Craig 1,160 ft. with 3 manholes, 2 lampholes and Y connections for house drains. Elsie M. Dupuis, City Clerk.

Minn., Minneapolis—Plans for radical change in city's sewer system, which would solve problem for St. Paul's water supply, being drawn tentatively by Minneapolis Civ. & Comm. Ass'n. Plan being worked out by A. B. Douglas, Engr. for Civic & Comm. Ass'n., calls for bldg. trunk sewers along both banks of river to empty below federal dam.

Minn., New Ulm—Bids will be asked in about 60 days for constructing 14 blocks of 10 to 24 in. sewers.

N. J., Egg Harbor City—City having plans prepared by Remington and Vosbury, Engrs. 6th and Market Sts., Camden, for sewage disposal plant and storm and san. sewerage system, involving 12 miles terra cotta pipe. Abt. $175,000.

N. J., Westfield—Borough having survey made by Remington & Vosbury, Engrs., 6th and Market Sts., Camden, for san. sewerage system, involving 20 miles terra cotta pipe.

N. M., Albuquerque—City plans constr. of storm sewers at est. cost of $75,000.

N. Y., Albany—City Engr. Lanagan has had survey made to fix location of new sewer in Arbor Hill to eliminate nuisance of drainage into the Tivoli Lakes. It is expected plans will be finished within a few days, when bids will be advertised.

N. Y., Syracuse—Common Council authorized constr. of sewage pumping station at Kirkpatrick and Van Rensselaer Sts., with comprehensive system of sewers draining barge canal harbor term. area.

Ohio, Shadyside—New sewer system planned for city. Entire project calls for expendt. of nearly $150,000. Mr. Althaar, Engr. for city.

Okla., Lawton—Engrs. V. V. Long & Co., 1300 Colcord Bldg., Okla. City, have submitted report for complete sewage disp. plant and sewage pumping station for treating a million and one-half of sewage per day. Est. cost $200,000. J. C. Talmadge, Commr. Pub. Property.

Wis., Darlington—Engr. W. F. Reichard, Watertown, preparing plans for sanitary sewers in Minerva and Louisa Sts., 8 to 12-in. vitr. pipe. J. G. Swift, city clerk., $25,000.

Wis., Whitefish Bay (Milwaukee P. O.)—City having plans prepared for concrete sewage disposal plant, filter neds and syphons. Abt. $20,000. Parsons & Orbert, 627 M. and M. Bank Bldg., Milwaukee, Engrs.

WATER SUPPLY AND PURIFICATION

Ark., Dumas—Council has passed Ord. for laying off and creating impvt. dist. for purpose of laying water mains. Jas. R. Moss, mayor.

Cal., Brea—$75,000 bond issue for municipal water system carried at special election. Project contemplates either purchase and impvt. of existing water plant or construction of entirely new plant, as may be found most expedient. Olmsted & Gillelen, Hollingsworth Bldg., Los Angeles, Cons. Engrs.

Cal., Riverside—Prelim. steps for sinking wells and constructing auxiliary pumping plant for city have been taken by Council, Bd. of Public Utilities and Park Comm. Project will cost $50,000.

Cal., Sacramento—City will enlarge its chlorine machine at water works, accord-

BUYERS' GUIDE

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L. The.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Warren Bros. C o.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Smith Co., T. L. The.

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co.

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Company.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

Road Oils and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
New Orleans Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros.

Sand Dryers.
Cummer & Son Co., The F. D.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
Clay Products Association.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
Crane Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.

Tar and Pitch.
The Barrett Co.
Philip Carey Co., The.

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith
Walter H. Flood
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Trinidad Lake Asphalt.
Barber Asphalt Paving Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Valves.
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.
McNutt Meter Box Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Winches, Vertical Capstan or Friction Drum.
Mead-Morrison Manufacturing Co.

Wire Rope.
American Steel & Wire Company

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

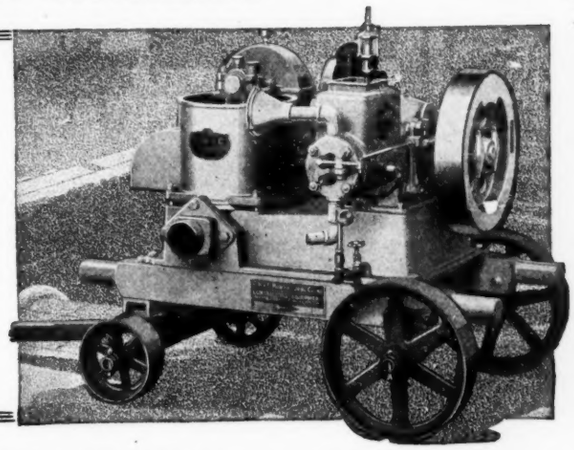
C.H.&E. POWER PUMPS

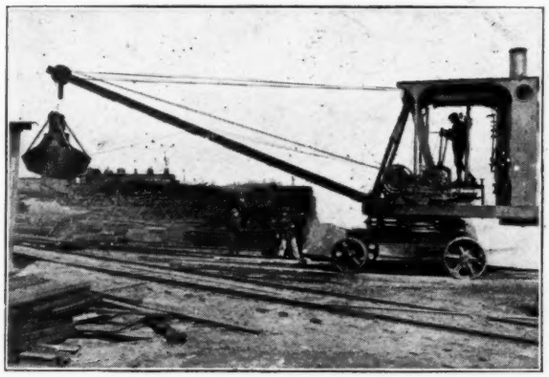
Pumps for Trench and Road Work. Also Saw Rigs, Hoists, Elevators, Mortar Mixers and Engines.

Immediate Shipment

C. H. & E. Manufacturing Co.

384 R, Clinton St. Milwaukee, Wis.





Full Revolving Self-Propelling

Locomotive Cranes

Mounted on Traction Road Wheels. Equipped with 30-ft. Booms and ¾-yard Clamshell Buckets.

ALL BRAND NEW

Road Builders' Equipment — Asphalt Plants
Revolving Traction Shovels — Road Rollers

F. MAYER, 53 W. Jackson Blvd., Chicago, Ill.

Contractors' Equipment of All Kinds

ing to city bacteriologist, J. R. Snyder.

Cal., San Diego—Council has passed emergency ordinance appropriating $10,000 to repair wood pipe line carrynig city water supply to the filtration plant at Lower Otay.

Cal., Santa Ana—$433,000 bond issue for additions to city water plant carried at special election.

Ont., Chatham—Engr. Proctor, Toronto, will supervise and carry out temporary improvement at local water works. Est. cost, $50,000.

Ont., Eastview—Council has decided to have 11,000 ft. water main extensions laid. $64,000. H. R. Washington, Clk. Cummings Bridge.

Alta., Edmonton—City Commrs. have decided to extend water works to serve the Gallagher Flats district. Est. cost, 210,000. C. E. K. Cox, city clerk.

N. S., Halifax—City Council plans to build an extension to water works system. About $150,000.

Ont., London—Council gave first and second readings to by-law to raise $80,000 for extension of water works system. Ont. Railway and Municipal Board will be asked to approve issue.

Can., Montreal—The Shawinigan Water & Power Co. has sold bonds to amount of $4,000,000 for expansion and improvement program, including transmission line betw. Shawinigan Falls and Montreal; also new unit of 50,000 h. p. will be installed at the Shawinigan plant.

Ont., Stamford—Town contemplates construction of water works system to cost about $125,000. C. F. Munroe, clerk.

Ont., Toronto—Election will be held in January to determine $8,000,000 bond issue for water works system. R. C. Harris, city engr.

Ont., York Twp.—Twp. Council has authorized laying of water mains on following avenues: Valedonia, Gilbert, McRoberts, Fife, and sects. of 15 other thoroughfares. Engr. Frank Barber, 40 Jarvis St., Toronto.

Conn., Hartford—Engr. Olmsted, E. Hartford Fire Dist., will begin work on plans and cost for laying 8-in. water main on Conn. Blvd. into Meadow Section.

Ga., Greensboro—City may extend water works; $25,000 bonds.

Ill., Decatur—Increasing demand for water here has made it necessary to plan on enlarging filter plant. Council has, therefore, authorized Commr. Ruthrauff to take matter up with competent engineer with view to getting price on work here. $100,000 appropriated by Council for an addition to plant this year. It is likely work will start on project in near future. Commr. has been authorized to get plans and specfs. on four additional filters.

Ind., Ft. Wayne—Nicholas Hill and T. F. Ferguson, Engrs. New York City, will make survey of possible well water supply of city.

Ia., Atlantic—Plans for placing elevated reservoir in east sect. of city to furnish water for residents of La Vista Pl. and others residing in So. Chestnut Dist. being considered by Council. Committee investigating feasibility of bldg. supply reservoir in La Vista Pl. This may be elevated tank in order to supply needed pressure.

Kans., Portis—Plans being prepared and city will soon ask bids for constructing new water works system, to include new well and distributing system. Abt. $32,000. Archer & Stevens, 609 New England Bldg., Kansas City., Mo., Engrs.

La., Franklinton—$37,000 bonds voted to install water works, erect 50,000 to 75,000 gals. capacity steel tank on 125-ft. tower (steel).

La., Opelousas—City considering repairing, remodeling and enlarging water works; $150,000. Lately voted $250,000 bonds to improve water, electric and system systems.

Mass., Cambridge—Plans being prepared for filtr. plant to cost about $600,000. Johnson & Benham, 150 Nassau St., N. Y. City, Engrs.

Mass., Palmer—Thorndike Co. having plans prepared by Leary and Walker, Engineers, Times Bldg., New Bedford, for reservoir and water supply system.

Mich., Durand—City contemplates expenditure of $50,000 for improving water plant. New pumping equpt. and main extension included. R. A. Murdoch, Engr., Free Press Bldg., Detroit.

Minn., Cambridge—Negotiating bond sale for sewer and water works system; will probably take bids in fall. E. Lindahl, Vil. Clk. Druar & Smith, 514 Globe Bldg., St. Paul, Engrs.

Minn., Inf. River Falls—Council has decided to take up matter of securing installation of filtr. system at earliest possible date. Engineers' plans and est. cost will be secured.

Minn., St. Paul—Water Wks. Dept. contemplates tapping Miss. River at Fridley, near Anoka, to increase and improve St. Paul's water supply. J. W. Kelsey, Gen'l. Supt. of Water Dept. Est. cost, $750,000. It is also proposed to erect a new filtr. plant, which would make total cost of improvements $2,000,000.

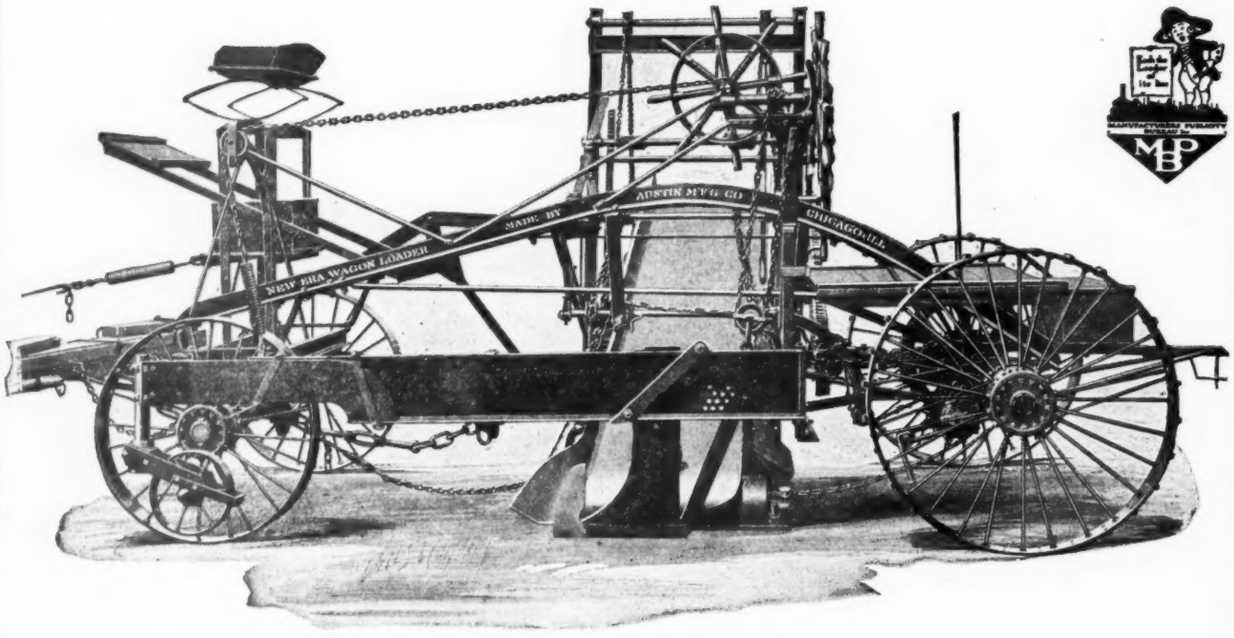
Mo., Carthage—$100,000 bonds authorized for improvements and extensions to municipal water works and electric light plant. J. D. Carter, mayor.

N. J., Avenal—Middlesex Water Co. requested to install water system here.

N. J., Bogota—Public Utilities Comm. requested to take steps to secure improvement of water system to provide adequate fire protection, as a result of citizens' demand.

Okla., Stigler—V. V. Long & Co., Engrs., Okla. City, have just made prelim. report on water works extensions, including water purification plant, pumping station and fire equipt. Est. cost, $35,000. Geo. Melton, city clerk.

Wis., Rhinelander—Engrs. Pearse & Greeley have submitted report to city recommending series of wells on west side. Mayor has appointed comm. to follow recommendations of engineers. H. L. Reeves, city engr. Jno. Gilligan, city clerk. Est. (including conduits), $130,000.



Elevating Graders

The remarkable quality standard of the Austin-Western Line of Road Machinery is forcefully expressed in the New Era Elevating Grader. Nothing has been omitted from either design or construction to make it an altogether reliable, efficient and highly productive Road Tool.

Built in two sizes, Junior or Senior, it is operated with from 12 to 16 horses or traction engine. Junior (the popular size for township road work) is equipped with a 19-foot carrier which can be reduced to 16 or 12 feet. Senior has a 22-foot carrier reduceable to 19 or 16 feet.

Daily capacity of the New Era is more than 1,000 cubic yards, and its simplicity of design throughout, together with its tremendous production powers, stamp this tool an unquestioned leader of its field.

Write today for catalog, specifications, prices, etc.

The Austin-Western Road Machinery Co.

CHICAGO, ILLINOIS.

New York	Richmond	Jackson	Memphis	San Francisco
Albany	Columbus	Dallas	Nashville	Los Angeles
Boston	Louisville	Oklahoma City	Pittsburgh	Portland
Philadelphia	New Orleans	St. Paul	Salt Lake City	Atlanta

EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

HAVE YOU ANALYZED YOUR ROAD PROBLEMS?

When the evidence is all in, this fact remains: The number of years the road lasts, divided by the first cost per mile, with maintenance expense added represents its true cost. First cost is important, but the possibility of extensive repairs, with its resultant outlay of money, is more so.

You must first of all, study local roadbuilding conditions. You must decide what kind and thickness of base your subsoil requires, what type and how thick a wearing surface is required, what material is available and how it can be most economically utilized, what are the most advanced methods used in modern road work, and where you can get the best engineering advice on the matter.

Dartmouth Street, Boston, Mass., June 15, 1914, from Marlborough Street, Looking toward Beacon Street. Warrenite-Bitulithic surface, laid on old macadam foundation in 1903.

WARRENITE-BITULITHIC

is a product evolved and developed by a group of the best engineers and chemists in the world. New conditions are constantly being studied and met at our laboratory with a view to meeting every possible situation.

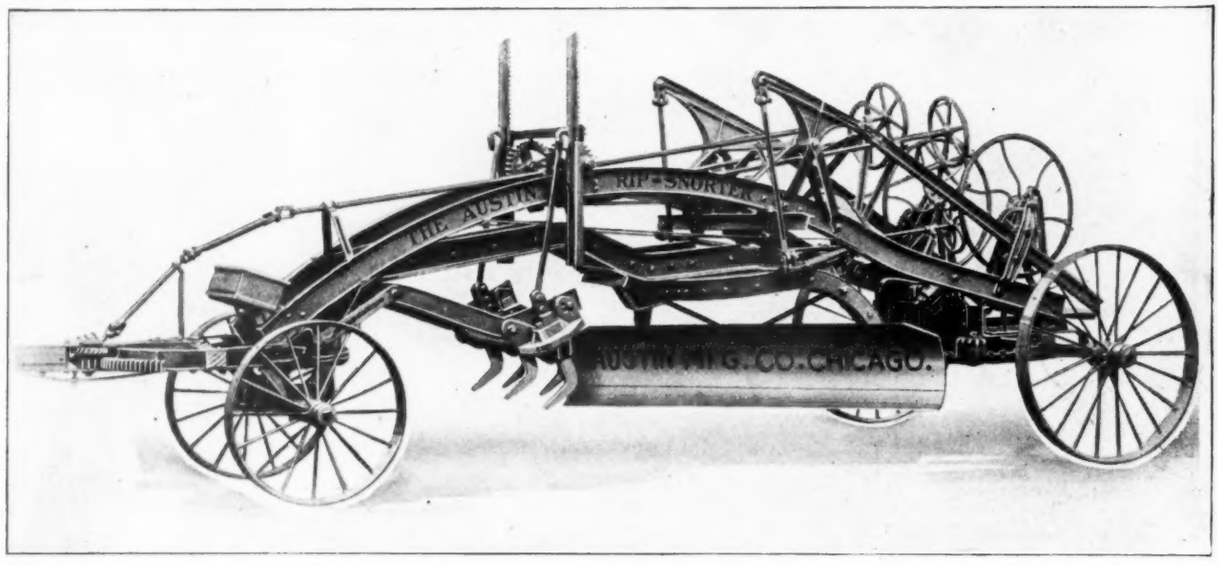
We desire to make your problems ours. After prescribing for your needs, we will place an inspector at your disposal to see that the specifications are properly carried out and that your community has a road or street that will measure up to your standard as well as to ours.

Warren Brothers Company

Executive Offices: BOSTON, MASS.

DISTRICT OFFICES:

New York, N. Y.
Utica, N. Y.
Portland, Ore.
Chicago, Ill.
St. Louis, Mo.
Phoenix, Ariz.
Washington, D. C.
Minneapolis, Minn.
San Francisco, Cal.
Richmond, Va.
Nashville, Tenn.
Los Angeles, Cal.
Vancouver, B. C.
Toronto, Ont.
Winnipeg, Man.

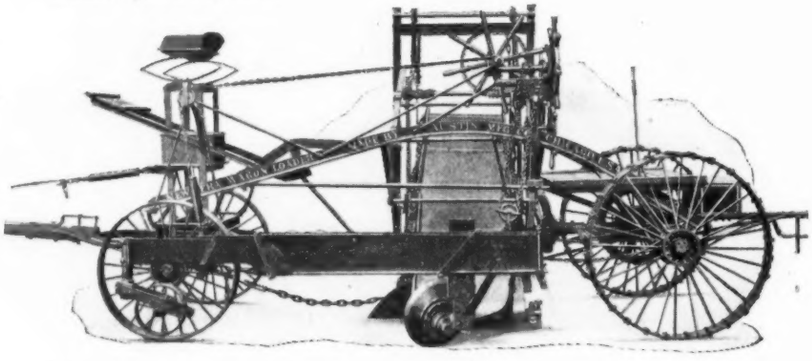


Operating Efficiency of Austin Road Machinery

FOR over half a century *operating efficiency* has been the dominant factor in the tremendous success of Austin-Western Road Machinery.

Expert engineering knowledge, coupled with years of practical experience with road building problems, has made possible the extraordinary performance powers of Austin machines.

The Ripsnorter and New Era Grader are two members of the Austin-Western family. Their success is both national and international. You can't go wrong with an Austin. Write today for catalog, specifications, prices, etc.



The Austin-Western Road Machinery Co.

CHICAGO, ILLINOIS.

New York	Richmond	Jackson	Memphis	San Francisco
Albany	Columbus	Dallas	Nashville	Los Angeles
Boston	Louisville	Oklahoma City	Pittsburgh	Portland
Philadelphia	New Orleans	St. Paul	Salt Lake City	Atlanta

EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA